

BRAZIL

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Brazil was Latin America's largest economy and the eighth largest worldwide and had a population of more than 174 million. The gross domestic product (GDP) was \$611.2 billion,¹ or \$1.34 trillion in terms of purchasing power parity in 2001. Brazil's GDP growth rate was 1.7% compared with 4.5% in 2000. Foreign exchange reserves decreased to about \$33 billion from \$36.3 billion in 2000 and the peak level of \$51.4 billion in 1997. Brazil's total debt burden amounted to \$216.5 billion. The trade balance increased substantially to \$2.6 billion surplus compared with \$749 million in 2000 and the peak level of \$6.6 billion in 1998. Exports were valued at \$58.2 billion, and imports, at \$55.6 billion. The growth of Brazil's economy slowed considerably in 2001 because of a slowdown in major markets (Europe, Japan, and the United States) and the increasing of interest rates by the Brazilian Central Bank to fight inflationary restraints. Inflation was 7.7% compared with 6% in 2000. Brazil's currency (real) devaluation helped moderate the downturn in economic growth of the second one-half of 2001, which was affected by the terrorist attacks of September 11 and the intensification of the Argentine crisis (Departamento Nacional de Produção Mineral, 2002a, p. 10; Ferraz, 2002, p. 1; Banco Central do Brazil, 2002c²; Economic Commission for Latin America and the Caribbean, 2002b³; U.S. Central Intelligence Agency, 2002³; World Bank Group, 2002³).

In 2001, foreign direct investment (FDI) inflows to the Latin American and Caribbean region amounted to about \$79.7 billion, which was almost 10% lower than that of 2000 (\$88.5 billion). Mexico, however, set a record of more than \$24.7 billion of FDI in 2001 followed by Brazil with about \$22.6 billion. Brazil's share of the region's net FDI inflows decreased by 31.1% compared with that of 2000 (\$32.8 billion) and was up from the \$1.5 billion at the beginning of the past decade (Banco Central do Brazil, 2002b³). Within the Mercado Común del Cono Sur (Mercosur), which included Argentina, Brazil, Paraguay, and Uruguay plus Bolivia and Chile as associated members, Brazil was followed at a considerable distance by Chile (\$4.6 billion), Argentina (\$3.2 billion), Bolivia (\$550 million), Uruguay (\$320 million), and Paraguay (\$152 million). Brazil was the largest recipient of FDI in the region for the sixth consecutive year largely because of the sale of state-owned assets, primarily in the service sector, telecommunications, energy, and finance, by the Government (Economic Commission for Latin America and the Caribbean, 2002a³).

In 2001, the Economic Commission for Latin America and

¹Where necessary, values have been converted from the Brazilian real (R\$) to U.S. dollars at the rate of R\$2.358=US\$1.00.

²References that include a section twist (§) are found in the Internet References Cited section.

the Caribbean reported that Brazil received \$1.1 billion of FDI in the finance sector for the privatization of the Banco do Estado de São Paulo. The International Monetary Fund endorsed Brazil's move to a system of inflation targets and currency devaluation to guide its monetary policy into 2002. This action indicated that the country could reduce its account deficit of \$35.2 billion down to an equivalent of 5.8% of the GDP thus helping restore confidence in the Government's economic management and creating conditions for lower interest rates and economic recovery (Banco Central do Brazil, 2002a³).

The Brazilian strategic plan Plano Real continued to be based on constitutional reviews, direct acquisitions of assets via mergers and joint ventures with the private sector, and macroeconomics to achieve its goals and to encourage new capital flows into the Brazilian economy. Given that the economy was in recovery, however, the currency devaluation and a tough fiscal austerity plan helped restore confidence in the Government's economic management and create favorable conditions for lower interest rates and Brazil's economic recovery that began in the second one-half of 2001 and continued into 2002. Brazil turned a fiscal deficit of 3% of the GDP in 1997 to a surplus of 3% in 1999 and 4.6% budget surplus in 2001 (Departamento Nacional de Produção Mineral, 2002a, p. 11; Banco Central do Brasil, 2002a³).

In 2001, Brazil's trade balance was affected by a reduction in demand and depressed prices for mineral exports and higher prices for crude oil imports. The mineral sector had a deficit of \$1.4 billion; if petroleum and its derivatives and natural gas were excluded, however, then the surplus would have been \$5.3 billion (Departamento Nacional de Produção Mineral, 2002a, p. 11).

Brazil produced 70 mineral commodities (45 industrial minerals, 21 metals, and 4 fuel minerals), such as bauxite, coal, columbium (niobium), chromite, gemstones, gold, iron ore, kaolin, manganese, tantalum, and tin from large deposits and exported them to the global marketplace in 2001. In Latin America, particularly within Mercosur, Brazil continued to be the leading producer of aluminum, cement, ferroalloys, gold, iron ore, manganese, steel, and tin. Brazil's reportedly large mineral reserves and other identified resources helped make it one of the most dynamic markets in the world and constituted one-third of the Latin American economy (Departamento Nacional de Produção Mineral, 2002a, p. 11). The country continued with its petroleum exploration program to expand reserves as well as to reduce dependence on oil imports, which satisfied about 24.2% of its crude oil requirements (Petrobrás, 2002, p. 4).

Brazil's petroleum and mining industries and utilities attracted investors' interest because of the country's diversified minerals endowment, the Government's macroeconomic

policies, and a skilled labor force. Major international mining, petroleum, and steel companies were notably interested in or very active by acquiring exploration properties, mining prospects, and steel firms. They were particularly interested in oil and gas, iron ore, steel, coal, gold, copper, and diamond, in order of importance.

The megamergers of British Petroleum Ltd. of the United Kingdom and Amoco Corp., Exxon Corporation and Mobil Oil Corp., and Chevron Corp. and Texaco Corp. of the United States, and others entered in joint-venture oil/gas projects with *Petróleo Brasileiro S.A. (Petrobrás)*. Petrobrás viewed such a trend of mergers as significant to improve and strengthen economies of scale, competitiveness, operational synergy, and regional strategies, which will impact future oil/gas joint ventures between Petrobrás and the private sector. Equally important to Brazil will be the Minas Gerais iron ore joint venture between *Companhia Vale do Rio Doce (CVRD)* and China's Shanghai Baosteel Group Corp. that will begin in 2002 and the Sossego copper-gold joint venture between CVRD and Phelps Dodge Corp. of the United States that also will begin in 2002 (Ferraz, 2002, p. 3; Metal Bulletin, 2001). Since 1991, the more than 500 transnational corporations that have established operations in Brazil have brought in \$240 billion in registered investment with the Banco Central do Brasil; of that total, \$57.1 billion was received by the minerals sector. The Banco Central do Brasil also reported that since 1996, the accumulated net FDI amounted to \$136 billion as equity capital, of which \$31 billion was used for acquisitions of state-owned assets and \$105 billion (excluded privatizations) was for direct acquisitions and joint ventures with the private sector (Banco Central do Brasil, 2002b§).

The list of active international mining and oil companies in Brazil included *Yacimientos Petroleros Fiscales* of Argentina; *BHP Minerals International Exploration Inc.* and *Western Mining Corp. Holdings Ltd.* of Australia; *Barrick Gold Corp.*, *INCO Limited*, and *TVX Gold Inc.* of Canada; *Shanghai Baosteel Group Corp.* of China; *EDP* of Portugal; *Anglo American plc*, *Billiton plc*, and *Rio Tinto plc* of the United Kingdom; *Iberdrola S.A.* of Spain; and *Enron Energy Corp.*, *ExxonMobil (Esso Brasileira de Petróleo Ltda.)*, *Newmont Mining Corp.*, *Placer Dome U.S. Inc.*, *Royal Dutch/Shell Group*, and *ChevronTexaco (ChevronTexaco Brasil S.A.)* of the United States (Ferraz, 2002, p. 4).

Government Policies and Programs

The legal framework for the development and use of mineral resources in Brazil was established by the Federal Constitution, which was enacted on October 5, 1988. On August 15, 1995, the Brazilian Congress approved Constitutional Amendments Nos. 6 and 9, which allow the participation of the private sector via joint ventures and/or privatization investment in the sectors of mining, natural gas, petroleum, and in the deregulated sectors of coastal and river shipping, telecommunications, and transportation. The 45-year Government monopolies of the oil and gas industries and fuel price subsidies were ended in 1999, thus allowing Petrobrás to enter into joint ventures with foreign investors. The *Agencia Nacional do Petróleo*, however, regulates the petroleum industry (Ferraz, 2002, p. 6; Pimentel,

2002a, p. 3-5). In 2001, other significant actions were undertaken by the Brazilian Government. The Brazilian import tax for minerals, in general, was reduced; the rates vary from 3% to 9%—ores and concentrates were 5%, and other products, 7%. The export tax does not apply to exported mineral products. The tax on industrialized products does not apply to mining activities, although there is a “value-added tax.” In most cases, the basis for assessment of corporate income taxes is the net profit for the fiscal year; the tax rate ranges between 10% and 15% and is levied on gross profit. Profits can be expatriated. Equity ownership, which is allowed via privatization or by direct acquisition, can be as high as 100% (*Departamento Nacional de Produção Mineral*, 2002c, p. 5-8; Pimentel, 2002b, p. 10-15). In 2001, the Concessions Law created additional opportunities for the private sector in public utilities previously reserved for the Government.

All the above actions, which were undertaken by the Government to open the Brazilian economy to international competition, have continued to create an environment that attracts domestic and foreign investments equally. The establishment of joint ventures in the sectors of construction and management of railroads, ports, telecommunications, and hydroelectric powerplants, metals, and oil and gas has become a common practice in Brazil.

The Brazilian Constitution and the Mining Code, law No. 9314 of January 1997, provide greater flexibility for investment in the Brazilian mining sector. Article 7 of this law stipulates that the exploitation of mineral deposits will depend upon an exploration authorization permit granted by the General Director of the *Departamento Nacional de Produção Mineral (DNPM)* and a Development Concession issued by the Minister of Mines and Energy. Licensing is a restricted system applicable exclusively to the exploitation of industrial minerals. The DNPM is responsible for enforcing this mining code and its complementary legal provisions. In 2001, the DNPM issued 32,000 exploration licenses compared with 21,200 in 2000 and reported an investment of \$180 million in mineral exploration compared with \$104 million in 2000. *Companhia de Pesquisa de Recursos Minerais (CPRM)* (the Brazilian Geological Survey) is developing programs for basic geologic mapping, metallogenetic and hydrogeologic mapping, and prospecting in areas of potential development, in addition to creating and maintaining geologic and economic data bases, particularly for coal, copper, diamond, gold, kaolin, nickel, peat, and zinc, to assist potential investors in the minerals sector. In 2000, a reorganization was proposed whereby the DNPM will be called the National Agency of Mining, and the CPRM will be called the National Geological Service (*Departamento Nacional de Produção Mineral*, 2002b, p. 25, 30-31; Ferraz, 2002, p. 1-2).

Environmental Issues

The Brazilian Environmental Policy (BEP) is executed at three levels—Federal, state, and municipal. The coordination and formulation of the BEP is the responsibility of the *Ministério de Meio Ambiente (MMA)*. Linked to the MMA is the *Conseho Nacional de Meio Ambiente*, which grants the environmental licenses that are required for all mining activities in Brazil. Law No. 88351 of 1986 established the National

System for the Environment, which comprises representatives of the Federal, State, and local governments and private foundations involved in environmental protection and improvement. Article 225 of the 1988 Brazilian Constitution stipulates that mining operators must reclaim areas that they have environmentally degraded. In Brazil, the environmental legislation applied to mining is basically consolidated in the following environmental requirements: environmental impact study (EIA), environmental licensing (LA), and plan for recovery of degraded areas (PRAD). An EIA applies to mining projects of any mineral substance; an LA is mandatory for installing, expanding, and operating any mining activity under the systems of mining concession or licensing; and a PRAD requires suitable technical solutions to rehabilitate the soil and other aspects of the environment that might be degraded by mining operations (Departamento Nacional de Produção Mineral, 2002b, p. 35-38). The Ministério de Minas e Energia enforces the 1989 decree, which prohibits the use of mercury and cyanide in the mining of gold unless approved by Brazilian local environmental agencies, and offers technical assistance on producing gold without affecting the environment to small-scale independent miners (*garimpeiros*), in particular. Environmental impacts are expected to be lessened in the future.

Resolution 010 of December 6, 1990, requires that all mining operations obtain LAs prior to the granting of mineral rights by the DNPM. As environmental problems have increased, antipollution measures have been enacted to eliminate the sources of pollutants and to mitigate their effects on the environment.

Production

In 2001, the total value of minerals produced (gas and crude oil included) was about \$9.4 billion, or about 1.5% of the GDP. The mineral-based industries amounted to \$51 billion, or about 8.3% of the GDP. Crude oil and natural gas amounted to almost \$6 billion. Mineral production contributed 3.4% of the GDP in 2001 compared with 11.1% in 2000, and that because the electricity rationing affected consumption and investment flows and the minerals sector performance decreased during the second one-half of 2001. Depletion of shallow gold and tin deposits and environmental constraints on *garimpeiros* affected their outputs of gold and tin (Departamento Nacional de Produção Mineral, 2002d, p. 21; Banco Central do Brasil, 2002c§).

The major integrated steelworks were the structure and rail producer Aço Minas Gerais, S.A., Latin America's largest integrated steelmaker Companhia Siderúrgica Nacional (CSN), the carbon steel sheet and plate producer Companhia Siderúrgica Paulista, the slab producer Companhia Siderúrgica de Tubarão, and Brazil's second largest steel mill Usinas Siderúrgicas de Minas Gerais, S.A. These companies produced about 17.1 million metric tons (Mt), or about 64% of the total Brazilian steel production of 26.7 Mt (Departamento Nacional de Produção Mineral, 2002d, p. 64). Brazil remained as the largest iron ore producer in the world with flat output in 2001 at 208.7 Mt. CVRD produced about 57% of the iron ore (Mining Journal, 2002c). Mineração Rio do Norte S.A. (MRN), the majority of which was privately owned, was the world's third

largest bauxite producer and exporter; it produced about 79% of the total bauxite production, which amounted to about 13.8 Mt. The four major aluminum smelters, Albras-Alumínio Brasileiro S.A., Alcoa Alumínio S.A., Companhia Brasileira de Alumínio, and Billiton Metais S.A., produced 87.9% of the primary aluminum production of 1.1 Mt (table 1).

Trade

Brazil was the largest open market and the economic center of Mercosur. In 2001, the member countries of Mercosur had almost 247 million people, 27.1% of the Western Hemisphere's population, and a combined GDP of almost \$2.0 trillion, which represented about 77% of South America's total GDP (Cowley, 2001). Brazil accounted for about 71% of Mercosur's population and almost 67% of its GDP (U.S. Central Intelligence Agency, 2002§). Most multinational companies considered this growing trade bloc, which was behind the North America Free Trade Agreement (NAFTA) and the European Union, to be extremely important because of its size and the amount of trade that takes place in the region. NAFTA has had an impact on Latin America and Caribbean Basin trade, which increased to about \$109 billion, or about 58% higher than that of 1991 (\$63 billion). When Mercosur is fully integrated, unrestricted movement of goods, labor, and services is expected to take place among the four principal members and the two associate members. Mercosur has had an impact on Latin intraregional trade, which increased to about \$30 billion in 2001 from \$7 billion in 1983. Intra-Mercosur trade amounted to \$20 billion, and mineral trade amounted to \$6.5 billion (Departamento Nacional de Produção Mineral, 2002a, p. 16-17).

In 2001, Brazil sold 17% of its exports to the other Mercosur members and 26% to the other countries in Latin America. Total minerals trade between the major players of Mercosur, Brazil (\$1.7 billion) and Argentina (\$800 million), amounted to \$2.5 billion. Brazilian mineral imports were valued at \$13.0 billion, or 36.8% higher than those of 2000 (\$9.5 billion), and its total mineral exports were \$11.5 billion, or about 20% higher than those of 2000 (\$9.2 billion). The values of the principal exports were \$2.9 billion for iron ore; \$2.8 billion, steel products; and \$1.5 billion, aluminum. In addition to petroleum and derivatives (\$4.3 billion), other major mineral imports (\$1.9 billion) were, in order of importance, copper, phosphate rock, potash, sulfur, and zinc (Departamento Nacional de Produção Mineral, 2002d, p. 16; Ferraz, 2002, p. 6).

Brazil-U.S. trade relations during the past decade grew at an unprecedented rate. The U.S. imports were primarily manufactured and semimanufactured Brazilian goods of high aggregate value, such as steel and chemical products, as well as other commodity exports. Brazilian exports to Europe and Japan consisted mostly of raw materials—in order of importance, iron ore, manganese, marble, and granite, and agricultural commodities.

In 2001, total trade between Brazil and the United States was \$4.1 billion. Exports increased by 27.5% to \$3.1 billion, and imports decreased by 3.0% to \$1.0 billion. Brazil's mineral trade balance with the United States increased to a surplus of \$2 billion from a surplus of \$1.2 billion in 1999 (Departamento

Structure of the Mineral Industry

The mineral industry of Brazil was large by world standards. The major portion of the industry was partially or wholly owned by Brazilian corporations, private Brazilian investors, and/or foreign companies. The exceptions were the natural gas and petroleum industries, which were 100% Government owned through Petrobrás and comprised five subsidiaries—Petrobrás Distribuidora S.A., which was the petroleum products distribution company; Petrobrás Internacional, S.A., which was the foreign operating company; Petrobrás Transporte S.A., which was the company that constructed and operated pipelines, terminals, vessels, and facilities needed for the transportation and storage of oil and derivatives, natural gas, and bulk products; Petrobrás Química, S.A., which was the integrated refining-petrochemical operations company; and Petrobrás Gás S.A., which was the company that produced, traded, and distributed natural and liquefied natural gas, and fertilizers company (Petrobrás, 2002, p. 10-29).

The structure of the Brazilian mineral industry continued to change to a privately owned/Government-regulated regime from one that was Government owned/Government operated. Between 1991 and 2001, the Government privatized the telecommunications and electrical energy sectors, the steel industry, and CVRD. In addition, 40 cement companies were operating 64 cement plants and 7 grinding plants with a clinker capacity of 45 Mt, and 30 iron ore mining companies were operating 80 mines and 43 processing plants (Departamento Nacional de Produção Mineral, 2001, p. 159; 2002d, p. 45-46).

In 2001, Brazil's total labor force was nearly 80 million. Of this total, services represented 53%; industry, 24%; and agriculture, 23%. The unemployment rate was 6.4% (U.S. Central Intelligence Agency, 2002§). The minerals sector employed about 5% (960,000) of the industry total (19.2 million); this did not include the nearly 650,000 *garimpeiros* active in Brazil (Vale, 2002, p. 1). Employment in the mining sector continued its downward trend as Brazil's economy was affected by its recent slow economic recovery, electricity crisis, and the increases of efficiencies and productivities in the private sector that resulted from the joint ventures, mergers, and privatizations, particularly in the steel and mining sectors (table 2).

Commodity Review

Metals

Alumina, Aluminum, and Bauxite.—Primary aluminum production amounted to about 1.13 Mt of metal, or 11% lower than that (1.27 Mt) of 2000. Primary aluminum producers were Albras-Alumínio Brasileiro S.A. (29%), Alcoa Alumínio S.A. (23%), Companhia Brasileira de Alumínio (CBA) (19%), Billiton (17%), Alcan Alumínio do Brasil S.A. (8%), and Vale do Sul Alumínio S.A. (Aluvale) (4%) (Departamento Nacional de Produção Mineral, 2002d, p. 25). Bauxite production was 13.9 Mt, which was about the same level as that of the previous year. The MRN joint venture owned by CVRD (40%), Billiton

(14.8%), Alcoa (13.2%), Alcan (12%), CBA (10%), Norsk Hydro Group (5%), and Reynolds Alumínio do Brasil (5%) accounted for almost 81% of the total bauxite production (11.2 Mt) for 2001. Alumina production was 3.8 Mt, which was about the same level as that of 2000, of which a consortium led by Alcoa (54%), Billiton (36%), and Alcan (10%) produced 44%; Alumínio do Norte do Brasil S.A., 43%; and CBA, 13%. Exports amounted to 4 Mt of bauxite valued at \$110 million, 1.2 Mt of alumina valued at \$215 million, and 1.4 Mt of primary aluminum valued at \$1.7 billion (Departamento Nacional de Produção Mineral, 2002d, p. 25-26).

MRN planned to open its new mine, which has bauxite reserves of 800 Mt and a capacity of 2 million metric tons per year (Mt/yr), in the Papagalo plateau, Trombetas, Pará. The Papagalo Mine will maintain MRN's total bauxite ore production capacity at about 12 Mt/yr. CVRD was planning to invest \$400 million in the bauxite-alumina-aluminum sector. The Albras facility at Vila do Conde, Pará (CVRD, 51%, and Nippon Amazon Alumínio Co., 49%), produced 369,200 metric tons (t) of primary metal in 2001, and was to be expanded to 400,000 metric tons per year (t/yr) capacity at a cost of about \$100 million in the near future. Alcan invested \$370 million in expansions of its complex facility at Laminação de Pindamonhangaba in São Paulo to increase its production capacity to 280,000 t/yr from 120,000 t/yr in 2001.

The Alcoa aluminum smelter owned by Alcoa (53.66%) and Billiton (46.34%) at São Luiz, Maranhão, was expanded to 239,000 t/yr from 194,000 t/yr in 2001 at a cost of \$550 million. Alcan expanded its aluminum sheet production capacity to 120,000 t/yr from 100,000 t/yr in 2001, as a part of a \$380 million investment program and was planning to increase its primary capacity to 150,000 t/yr. Investments in the aluminum sector could reach up to \$1.6 billion within the next few years. Latapack-Ball S.A., which produced aluminum cans, invested \$5 million to increase its plant capacity in Jacareí, State of São Paulo, to 2 billion aluminum cans from 1.7 billion. Brazil's goal to recycle 80% of its aluminum cans was not achieved, but it came very close to its goal of 77% (Departamento Nacional de Produção Mineral, 2002d, p. 26; Ferraz, 2002, p. 2).

MRN was set up to mine the Oriximina bauxite deposit near the Trombetas River in conjunction with the Papagalo bauxite mine in Pará and will supply the feed to Alcoa's refinery at São Luís, Maranhão. CBA planned to invest \$700 million to produce 500,000 t/yr of alumina and to expand its aluminum capacity to 360,000 t/yr from 220,000 t/yr. Alunorte began an expansion program to increase its alumina production capacity by about 40% to 2.3 Mt/yr from 1.6 Mt/yr by 2005 (Departamento Nacional de Produção Mineral, 2002d, p. 26; Ferraz, 2002, p. 2, 6).

Columbium (Niobium) and Tantalum.—Brazil continued to be the world's most significant producer and main supplier of columbium to the global markets. Brazil produced about 92.4% of the world's total output, or 31,200 t of pyrochlore (Nb₂O₅) in concentrates, 18,218 t of columbium in alloys, and 1,274 t of columbium in oxides from two open pits located in Araxá, State of Minas Gerais, and Catalão, State of Goiás. In 2001, Mineração Catalão de Goiás Ltda. (MCGL) (a joint venture of Bozzano Simonsen S.A. of Brazil, 68.5%, and Anglo American,

31.5%) and Companhia Brasileira de Metalurgia e Mineração (CBMM) (a joint venture of Grupo Moreira Sales S.A. of Brazil, 55%, and Molycorp, Inc. of the United States, 45%) accounted for 61.5% and 38.5%, respectively, of Brazil's 65,000-t/yr pyrochlore production capacity. The columbium plants of CBMM in Araxá and MCGL in Ouvidor accounted for about 88% of Brazil's pyrochlore production and supplied about 79% of the world demand for ferrocolumbium. The Araxá, Catalão, and Ouvidor columbium ore deposits contained 90% (5 Mt) of the world's pyrochlore reserves. Tantalum production totaled 50 t. The Araxá deposit, which was considered to be one of the world's largest (450 Mt with 2.5% Cb_2O_2) and most economically viable ore body, produced 50,400 t in 2001. The upward trend in tantalum supply will continue in response to increased world demand (Departamento Nacional de Produção Mineral, 2002d, p. 83-84).

Copper.—Copper concentrate production amounted to 32,000 t, which was a very small increase compared with that of 2000. The concentrate was produced by Mineração Caraíba S/A's [Grupo PARANAPANEMA (GP)] deposit in Jaguari, State of Bahia, which was Brazil's only underground copper mine (Departamento Nacional de Produção Mineral, 2002d, p. 41).

In 2001, Caraíba Metais S/A (CMSA) of Camaçari, Bahia, produced 185,345 t of primary copper metal, which was a decrease of 4% compared with that of 2000; this also included 486,700 t of copper concentrates imported from Chile (65%), Peru (14%), and other countries (21%). CMSA, which was the only electrolytic copper producer to meet Brazil's metal copper demand of 335,200 t/yr, imported 148,000 t of copper cathode, mostly from Chile (85%) and Peru (13%), in 2001 (Departamento Nacional de Produção Mineral, 2002d, p. 41-42).

In 2001, the reserves at Cobre Salobo, which was Brazil's largest copper project, were estimated to be 1,900 Mt at a grade of 0.65% copper and contained 0.96% copper-equivalent associated with gold, silver, and molybdenum, in order of importance. These reserves could support a 250,000-t/yr production capacity of refined copper with byproducts of gold, silver, and molybdenum, in order of added value. The project, which is in Marabá, Pará, was a joint venture of Anglo American, the Brazilian Banco Nacional de Desenvolvimento Econômico e Social, and CVRD; each member held a one-third interest. The Salobo copper project was going through a reassessment process owing to the depressed prices for copper in 2001 (Departamento Nacional de Produção Mineral, 2002d, p. 42). CMSA's Camaçari refinery in Bahia State expanded its cathode capacity to produce 220,000 t/yr of refined copper with an investment of \$14 million in 2001. A feasibility study on the Chapada copper project (owned by Mineração Maracá S.A.) in Alto Horizonte, Goiás, estimated that its ore reserves were 434.5 Mt and contained 1.3 Mt of copper and 9.6 t of gold. The Cobre Sossego project, Cristalino, and Corpo Alemão in Carajás, Pará, are being explored by Mineração Serra do Sossego S.A. (a joint venture between CVRD and Phelps Dodge Corp.); current resources of copper were estimated to be 400 Mt at a grade of 1.14% copper and 0.34 gram per metric ton gold (Departamento Nacional de Produção Mineral, 2002d, p.

42).

Brazil's refined copper production was used primarily in the automobile and construction industries. Exports amounted to 55,700 t of copper metal valued at \$100 million, which went to Chile, 39%; Argentina, 33%; and the United States, 28% (Departamento Nacional de Produção Mineral, 2002d, p. 41-42).

Gold.—Gold production was reported by the DNPM to be 50.5 t, which represented 42 t from mining companies and 8.5 t from garimpeiros; this output was 8 t lower than that of 1997, which had the highest levels of output during the past 4 years (table 1). Gold production from the garimpeiros and the private sector decreased because of higher production costs, depletion of shallower deposits, lower prices in the international market, and much higher environmental standards. CVRD, which was the largest gold producer, reported 18 t; AngloGold Ltd. of South Africa, which was the second largest gold producer, reported 13 t, of which Mineração Morro Velho S.A. (owned by AngloGold) produced 7 t and Mineração Serra Grande S.A. (owned by AngloGold), 6 t. Rio Paracatu Mineração S.A. (owned by Rio Tinto, 51%, and Autram S/A, 49%) continued to be the third largest gold producer with 7 t. São Bento Mineração S.A. (owned by Eldorado Gold Corp.) was the fourth largest producer with an output of 4 t. Refined gold from the São Bento Mine was extracted by a combination of pressure oxidation and bioleaching (biox process) developed by Gold Fields Ltd. and Mintek Ltd. of South Africa. Mineração Maracá S.A.'s São Vicente Mine in Mato Grosso produced 1.5 t of gold. Production at the São Vicente Mine will be expanded to about 10 t of gold during 2003 to 2004 (Departamento Nacional de Produção Mineral, 2002d, p. 55-56).

Brazilian gold production could increase significantly in the foreseeable future because of the growth of Brazilian copper production and of increased interest by domestic and foreign investors in largely unexplored areas in spite of the depressed gold market prices in 2001. More than 2,000 gold occurrences, which are mostly Precambrian vein deposits and alluvial placers, were known (Departamento Nacional de Produção Mineral, 2001, p. 192; Ferraz, 2002, p. 4).

AngloGold was planning to spend \$50 million to implement the Amapari gold project in the State of Amapá, which will begin operating next year, and \$6 million to explore for gold near to the Pedra Branca do Amapari in the Amazon region (Departamento Nacional de Produção Mineral, 2002d, p. 56).

Iron and Steel.—Ferroalloys.—Ferroalloy production decreased to 734,000 t in 2001 from 884,000 t in 2000; this significant decrease of almost 17% in ferroalloy output was the result of the country's worst drought in decades that affected the hydroelectric power supply system. For the year, steel production amounted to 26.7 Mt, which represented a decrease of 2.1% compared with 2000. Brazil was the third largest ferroalloy producer in the world (Departamento Nacional de Produção Mineral, 2002d, p. 62). Apparent domestic consumption was about 740,000 t. Brazil's Prometal Produtos Metalúrgicos S.A. took Norway's Elkem A/S, which was one of the world's largest manganese alloy producers, as a partner to produce a projected 500,000 t of ferromanganese by 2004; the

project, in which Elkem will hold a 40% share, was in Marabá, Pará. The manganese will come from the nearby Prometal Mine, and the iron ore will come from the Carajás district. Nova Era Silicon S.A. [a joint venture among CVRD (49%), Mitsubishi Corp. (25.5%), and Kawasaki Steel Corp. (25.5%)] was building a silicon ferroalloy plant in Nova Era, Minas Gerais, with an installed capacity of 48,000 t/yr. About two-thirds of its output was exported mainly to Japan, during 2000 to 2001 and will continue between 2002 and 2010 (Departamento Nacional de Produção Mineral, 2002d, p. 62).

Iron Ore.—Brazil produced 208.7 Mt of beneficiated iron ore compared with 208.8 Mt in 2000. About 96% of that production was from the major iron ore companies—CVRD; Minerações Brasileiras Reunidas S/A (MBR) (equally owned by CVRD and Mitsui e Co. Ltd. of Japan); Ferteço Mineração S.A., S.A. Mineração da Trindade (SAMITRI), Samarco Mineração S.A., CSN, SOCOIMEX S.A., and Itaminas Comércio de Minérios S.A. In 2001, Brazil exported 155.7 Mt of iron ore and pellets valued at \$2.9 billion (Departamento Nacional de Produção Mineral, 2002d, p. 61-62).

The total iron ore exports were 2.7% lower than those of 2000 and were shipped to 40 countries worldwide. Total export revenues decreased by almost 5% from \$3.05 billion in 2000. The major importers of Brazilian iron ore were Japan (18%), Germany (14%), China (9%), the Republic of Korea (7.6%), Italy (6%), the United States (5.2%), Belgium (4.8%), France (4.1%), Spain (3.8%), and Argentina (3.3%). The customized commercial products (varied chemical characteristics) sold were sinter feed and pellet feed (70.3%), pellets (21.4%), and lump ore (8.3%) (Departamento Nacional de Produção Mineral, 2002d, p. 62).

CVRD and Pohang Iron and Steel Co. of the Republic of Korea invested \$220 million to produce 4 Mt/yr of pellets. The facility is in the port of Tubarão, Espírito Santo. CVRD was planning a new \$400 million pelletizing plant with railroad and port facilities in São Luiz, Maranhão. MBR opened three new mines—Capão Xavier, Capitão do Mato, and Tamandua—in Minas Gerais to increase capacity to 32 Mt/yr in 2004 and to offset the iron ore depletion at the Aguas Claras and the Matuca Mines. Mineração Corumbaense S.A. (a subsidiary of Rio Tinto) was planning a \$200 million plant at Corumba in the State of Matto Grosso to produce 1 Mt/yr of hot-briquetted iron to supply steel plants in Argentina. This facility will use natural gas from the 3,150-kilometer (km) pipeline between Bolivia and Brazil that connects the Santa Cruz de la Sierra, Bolivia, to Campinas, State of São Paulo (Departamento Nacional de Produção Mineral, 2002d, p. 62).

During 2000 to 2001, CVRD acquired the following Brazilian enterprises: SOCOIMEX (100%), which had the capacity to produce 7 Mt/yr of iron ore, for \$48 million; Gulf Industrial Company (50%), which was the owner of a pellet plant in Bahrain with a 4 Mt/yr capacity, \$92 million; and SAMITRI (51%), \$711 million. Caemi Mineração e Metalurgia S.A., which controlled 85% of MBR, 10% was held by a consortium of Japanese steel producers, and 5% by CVRD directly, which was acquired from Bethlehem Steel in late 2001. CVRD was planning to invest about \$6 billion to focus in the mining sector by 2007 (Ferraz, 2002, p. 4-5; Mining Journal, 2002b, c).

Pig Iron.—Brazil produced 27.8 Mt of pig iron, which was about the same level as that of 2000. The 2.5 Mt of exports, which was valued at \$290 million, was approximately one-third of the pig iron traded in the world (Departamento Nacional de Produção Mineral, 2002d, p. 62).

Steel.—Brazil's 2001 steel production totaled 26.7 Mt, which was a 2.1% decrease from that of 2000; this places the country fifth in the world (Fenton, 2002). The major recipients of Brazil's exports were Asia (5 Mt), Latin America (2 Mt), and the United States (1.4 Mt) (Instituto Brasileiro de Siderurgia, 2001, p. 32). The Instituto Brasileiro de Siderurgia (IBS) stressed that the Brazilian steel industry needed to become more efficient because privatization has fundamentally improved efficiency and reduced employment levels of the Brazilian steel industry. The IBS believes that vertical integration was evident as customers and suppliers of the steel companies participated in the auctions. The Government's privatization program identified the Brazilian steel industry as one of the first sectors for auction via the stock exchanges of Rio de Janeiro and São Paulo. The state-owned steel companies were largely privatized between 1991 and 1993 (Ferraz, 2002, p. 6).

Manganese.—In 2001, Brazil produced 2.2 Mt of manganese ore, which was about the same level as that of 2000. CVRD's high-grade manganese mine Igarapé Azul in the Carajás Complex accounted for 70% of metallurgical manganese production, which was about the same level (1.4 Mt) as that of 2000. Construtora Polares Ltda. a medium producer and small producers (in order of importance, in the States of Minas Gerais, Goiás, and Bahia), produced 177,000 t of manganese ore, which was 0.6% higher than that of 2000. Exports of manganese ore accounted for 1.2 Mt valued at \$140 million; this export increase of almost 96% was due to a higher demand for steel. Manganese ferroalloys exports also increased by 62.7%, which amounted to 136,000 t valued at \$60 million (Departamento Nacional de Produção Mineral, 2002d, p. 73-74; Ferraz, 2002, p. 6).

Nickel.—Brazil produced about 2.8 Mt of nickel ore with a nickel content of 45,300 t, which was about the same level as that of 2000. Mineração Serra da Fortaleza in Fortaleza de Minas, Minas Gerais (owned by Rio Tinto), produced 8,500 t of nickel contained in matte, which was 8% lower than that of the previous year; Companhia Niquel Tocantins of Grupo Votarantin (GV) in Niquelândia, Goiás, produced 17,200 t of nickel contained in carbonates obtained by ammoniacal leaching, a hydrometallurgical process; this was about the same level as that of 2000. Also in the same district, CODEMIN S.A. of Anglo American produced 6,300 t of nickel contained in ferronickel alloy, which was 2.4% lower than that of 2000 (Departamento Nacional de Produção Mineral, 2002d, p. 81-82; Ferraz, 2002, p. 4).

Owing to the increase in world demand for stainless steel and better nickel prices, investments of \$1.4 billion in the Brazilian nickel industry are planned to increase the production capacity to 107,000 t/yr from 34,000 t/yr starting in 2003. CVRD intended to invest \$600 million to produce 30,000 t/yr nickel from its Vermelho project in Carajás, Pará, which contains

reserves of 100 Mt at a grade of 1.5% nickel; Anglo American will develop the Barro Alto nickel project in Goiás, by investing \$750 million to produce 40,000 t/yr of nickel from a deposit with 117 Mt at a grade of 1.5% nickel; Companhia Niquel Tocantins will increase production capacity to 20,000 t/yr from 17,000 t/yr at a cost of \$50 million in Niquelândia, Goiás; and Falconbridge Limited of Canada, which was world's third largest producer of refined nickel, entered into exploration negotiations with the Brazilian Government for sulfide and lateritic nickel in the country in 2000. Thus far, Falconbridge had invested \$500,000 for preliminary research and map collection with CPRM and DNPM (Departamento Nacional de Produção Mineral, 2002c, p. 81-82; Ferraz, 2002, p. 4).

Tin.—Brazil was the world's fourth largest tin producer after China, Indonesia, and Peru (Carlin, 2002). Tin production was 14,200 t of tin contained in concentrate and 13,800 t of metal; this was an increase of about 3.1% of tin concentrate; the metal content was about the same level as that of 2000. During the past 5 years, production cuts were made at the Pitinga Mine in the State of Amazonas, which was operated by Marmoré S.A. (GP), and at the garimpeiros' Bom Futuro operations in the State of Rondônia. Marmoré's mine produced 11,750 t compared with 11,200 t in 2000; byproducts were, in order of importance, columbium (niobium), tantalum, zirconium, hafnium, thorium, and cryolite. Marmoré was planning to develop its Rocha Sa project to increase total tin output to 14,300 t/yr by 2004 (Mining Journal, 2002d). Exports increased to 7,860 t valued at \$36.1 million from 7,161 t valued at \$35.3 million in 2000. During the past 5 years, the highest exports were registered in 1997 (11,957 t valued at \$62.5 million). These exports were far below the quota of 20,185 t/yr assigned to Brazil by the Association of Tin Producing Countries. Shipments were made to Argentina (55%); Belgium, Spain, and others (32%); and the United States (13%). Amazonas (72%) and Rondônia (25%) continued to be the major producers in the country (Departamento Nacional de Produção Mineral, 2002d, p. 83-84; Ferraz, 2002, p. 4-5).

Zinc.—Brazil produced 100,300 t of zinc in concentrates, which was about the same level as that of 2000. GV's Companhia Mineira de Metais S.A. (CMM), which was the only producer of zinc ore in Brazil, produced 27,800 t of zinc sulfide concentrates in Paracatu, which was about 1% higher than that of 2000, and 72,480 t of zinc silicate in Vazante, which was about the same level as that of 2000 (Departamento Nacional de Produção Mineral, 2002d, p. 119-120). The concentrates were processed in CMM's plant in Três Marias and GP's Juiz de Fora Complex in Minas Gerais. These zinc refineries produced 192,000 t of primary metal, which was about the same level as that of 2000. CMM produced 111,360 t (58% of the total), which was an increase of 1.2% compared with that of 2000, and GP's Companhia Paraibuna de Metais S.A. produced 81,100 t, which was an increase of 4.5% compared with that of 2000 (Ferraz, 2002, p. 5).

To meet Brazil's demand for zinc, which was about 190,000 t/yr of metal, the country imported 187,000 t of zinc concentrates (valued at \$64 million), which was 13.5% lower than that of 2000 (216,287 t valued at \$72.9 million), and

26,575 t of metal, which was 23.6% higher than that of 2000. Peru supplied 95% of the concentrates and 13.5% of the metal; additional needed zinc metal was supplied by Argentina (72.2%) and the United States (3.6%) (Departamento Nacional de Produção Mineral, 2002d, p. 119-120; Ferraz, 2002, p. 5).

To identify additional zinc reserves in Paracatu and to expand the Três Marias zinc refinery to 165,000 t/yr from 110,000 t/yr by early 2003, CMM was planning to invest \$8 million and \$160 million, respectively (Departamento Nacional de Produção Mineral, 2002d, p. 120).

Industrial Minerals

Asbestos.—Brazil's significant asbestos deposits were in Minaçu, Goiás; Goiás was the only producing State in the country. Sociedade Anônima Mineração de Amianto produced 209,300 t of asbestos fiber, which was about the same level as that of 2000. Almost 80% of Brazil's asbestos production was consumed in the manufacture of specialized cement products, such as ceiling tiles, protective screens, water and sewer pipes, water tanks, and molded electrical insulators. Other uses were in thermal insulators, paper and cardboard, slabs, decorations, insecticide, asphalt for highways and airport runways, and the automobile industry (Departamento Nacional de Produção Mineral, 2002d, p. 43-44; Ferraz, 2002, p. 5).

Brazil exported about 34.7% of its production mainly to India, 37%; Thailand, 11%; Japan, 10%; Mexico, 9%; and Indonesia, 6%; these exports were 28% higher than those of 2000. The State of São Paulo was the country's largest consumer followed by Paraná and Rio Grande do Sul. Asbestos mining and consumption have been highly regulated in most industrialized nations, thus forcing them to reduce production and consumption. Industry experts expected asbestos use in the industrial nations to continue to decline. In contrast, the world's developing economies were expected to increase their collective asbestos consumption by large margins. Brazilian asbestos reserves (16 Mt) were considered to be adequate to meet demand in the short to medium term; the average grade of ore from the Cana Brava Mine in Minaçu was 5.235%, and its reserves (fiber content only) were 3 Mt, which, at a production rate of about 200,000 t/yr, represented a 15-year mine life (Departamento Nacional de Produção Mineral, 2002d, p. 43-44).

Cement.—The country produced 39.5 Mt of cement, which was almost 1% higher than that of 2000. Among the 21 State producers, Minas Gerais was the most important with 22.8% of the total followed by São Paulo (19.7%), Paraná (9.7%), Rio de Janeiro (7.4%), Sergipe (4.8%), Rio Grande do Sul (4.5%), and others (31.1%). The main producers were GV's Companhia Cimento Portland Itau (21.5%) and Companhia Cimento Portland Rio Branco (20.3%), Grupo Swiss Holderbank's Holder Cimento S.A. (9%), Grupo Lafarge's Companhia Cimento Portland Paraiso (8.3%), Camargo Correia Cimentos S.A. (8.1%), and others (32.8%). Most of the exported cement (185,800 t) went to Argentina (43.3%), Paraguay (40.2%), Bolivia (6%), Peru (2.4%), and Colombia (1.3%). Brazil imported 157,300 t of cement mainly from Mexico (43.9%), Colombia (21%), France (15.3%), and Belgium (10.4%).

Camargo Correia Cimentos S.A. was investing \$200 million to build a new 1.6 Mt/yr cement plant in Ijaci, Minas Gerais, that will begin operations in early 2003. Grupo Cimentos Portland S/A (CIMPOR) will invest \$180 million to build two cement plants in the State of Paraíba. CIMPOR will produce 1.7 Mt/yr of cement in 2003 (Departamento Nacional de Produção Mineral, 2002d, p. 33-34).

Clays.—Brazil had 4,000 Mt of kaolin reserves, or about 28.2% of the world's total. Production of beneficiated kaolin was about 1.7 Mt, which was about the same level as that of 2000. The beneficiated kaolin was either coating or filler kaolin. In 2001, Caulim da Amazônia S.A. (CADAM) of Pará accounted for 43.5% (756,000 t) of the country's total output, the State of Pará contributed with 704,500 t of beneficiated kaolin via Pará Pigmentos S.A. (PPSA) and Ymerys Rio Campin Caulim S.A. (RCCSA), and the remainder (274,500 t) was produced by small producers in the States of Minas Gerais, Rio Grande do Sul, and São Paulo. Brazilian kaolin exports were 20% higher than those of 2000, or about 1.4 Mt valued at \$160 million. Shipments were made to Belgium (40%), Japan (18%), Italy (16%), the Netherlands (10%), the United States (9%), and other countries (7%). Depending on market conditions, RCCSA was planning to expand its capacity to 600,000 t/yr by 2002, PPSA was considering expansions that would increase its capacity to 550,000 t/yr by 2002, and CADAM was expected to increase production of coating kaolin to 1 Mt in 2002. In Brazil, kaolin consumption decreased by about 1.5% to 339,365 t from 344,533 t in 2000. Kaolin was used mainly in the ceramics and paper industries and, to a lesser degree, in the manufacture of rubber, plastics, pesticides, animal feed, food supplements and pharmaceuticals, fertilizers, and paint, as well as many other applications (Departamento Nacional de Produção Mineral, 2002d, p. 63-64).

Fluorspar.—Production of beneficiated fluorspar totaled 43,000 t, which was about the same level as that of 2000 (42,962 t). The beneficiated fluorspar was either acid or metallurgical grade. Crude-ore [run-of-mine (ROM)] production was 131,000 t, which remained at about the same level as that of 2000 (130,976 t). The decline of ROM production during the past 3 years was due to the shutdown of Mineração Nossa Senhora do Carmo Ltda.'s (MNSCL) Fumaça and Pedras Grandes fluorspar mines. ROM production, by mine, in Santa Catarina State was at Morro de Fumaça (34.7%), Rio Fortuna (26.3%), and Santa Rosa de Lima (22.3%), and in Rio de Janeiro State, at Tanguá (16.7%). MNSCL was planning to acquire Mineração Del Rey Ltda.'s Cerro Azul Mine in Paraná State to start production and to increase domestic production in 2004 (Departamento Nacional de Produção Mineral, 2002d, p. 51-52).

Gemstones.—Brazil continued to be one of the world's largest gemstone producers and exporters. Many different varieties of gemstones are found throughout the country; these include, in order of importance, emerald, aquamarine, diamond, amethyst, citrine, chrysoberyl, opal, topaz, agate, and tourmaline. Brazil is the world's only source of some quality gemstones, such as imperial topaz and Paraíba tourmaline

(Oliveira, 2002).

In 2001, mining of gemstones continued to be dominated by the garimpeiros. Brazilian production of gems (including diamond), which totaled 1 million carats, was mainly derived from digging activities (garimpos), which amounted to 820,000 carats, or 82% of the total; the private sector produced 80,000 carats, or 8% of the total (table 1). Garimpeiros' production, however, continued to decline because of depletion in garimpos' reserves and increase in environmental restrictions. By the end of 2001, some high-content gem placers in indigenous reserves were closed by the Government to exploration, the jewelry industry's gemstone consumption was unknown, taxation on domestic sales of jewelry was high, and the private sector faced severe competition from its black-market counterparts. Taking into consideration these factors, Brazil's gemstone reserves were almost impossible to quantify. Brazil, however, may have great potential because the country has 600 million cubic meters of sedimentary rocks that contain diamond that grade between 0.01 and 0.1 carat per cubic meter, or 15 million carats; this represented about 1.2% of the world's diamond reserve base (Departamento Nacional de Produção Mineral, 2002d, p. 45-46; Olson, 2002, p. 56-57).

Diamond production remained about the same level as that of 2000. The total value of gemstone (including diamond) production was \$48 million. Total exports of uncut gemstones were about \$13 million, which remained at about the same level as that of 2000 but was lower than the \$15.8 million in 1998 and \$34.6 million in 1997. The major markets for uncut stones were Belgium (95%) and for cut stones were the United States (55%), Argentina (15%), Japan (12%), Paraguay (9%), Germany (6%), and Bolivia (3%). Imports increased to \$21.5 million from \$20.6 million in 1999 and \$17 million in 1998. The main sources for uncut stones were Ireland (48%), the United States (36%), and the United Kingdom and Germany (8% each), and for cut stones, Italy (31%), China (25%), Japan (14%), and the United States and Spain (15% each). Brazil had lapidarian centers, many of which have closed owing to the preference of foreign buyers for uncut stones (Departamento Nacional de Produção Mineral, 2002d, p. 45).

Graphite.—Historically, Brazil's beneficiated natural graphite output had been centered in Minas Gerais. Nacional de Grafite Ltda. (NGL) mined natural graphite in the municipalities of Pedra Azul, which had a production capacity of 30,000 t/yr; Itapecerica, 11,000 t/yr; and Salto da Divisa, 6,000 t/yr. Production amounted to 71,000 t with 14% carbon content; this was about the same level as that of 2000. This production was mainly of products that ranged in grade from 65.5% to 99.9% carbon at NGL's three plants in Pedra Azul (31,100 t), Itapecerica (13,400 t), and Salto da Divisa (6,100 t). Also in Minas Gerais, Grafita MG Ltda. produced about 16,570 t of natural graphite, which was 10.5% higher than that of 1999 and was consumed domestically after simple grinding, and GP's Mamoré Mineração e Metalurgia Ltda. in Maiquinique, Bahia, produced 3,830 t of natural graphite (Departamento Nacional de Produção Mineral, 2002d, p. 57-58).

Three types of beneficiated graphite products were processed by NGL in Itapecerica and Pedra Azul—fines, lump, and medium grained. Brazil's demand for natural flake-type

crystalline graphite was met by the the Itapeceira, Pedra Azul, and the Salto da Divisa beneficiation plants. Exports amounted to 17,994 t valued at \$19 million in 2001 compared with 11,307 t valued at about \$18 million in 2000. Growth of the domestic consumption of natural graphite during the 1990s was correlated with that of the iron and steel industries, which absorbed about 80% of the natural graphite consumed in Brazil; demand in 2001, however, increased by about 41.6% (51,000 t) compared with that of 2000 (36,000 t). Other consumers included battery manufacturing (6.5%), refractories (6%), paint and varnishes (2%), and other miscellaneous uses (5.5%) (Departamento Nacional de Produção Mineral, 2002d, p. 57-58).

Magnesite.—The most important magnesite mine in Brazil was the Pedra Preta Mine, which was owned and operated by Magnesita S.A. (MSA); the mine is in the Éguas Mountain region of Brumado, Bahia, about 610 km from Salvador. Brazil produced 280,000 t of beneficiated magnesite, which was about the same level as that of 2000; MSA produced 97% (271,600 t). Exports of processed magnesite totaled 78,000 t valued at \$12 million and were shipped to Paraguay (25%), Poland (20%), the United States (16%), Argentina (15%), and Chile (11%). Imports totaled 7,600 t valued at \$5 million and were imported from Norway (69%), Canada (21%), Mexico (3%), and other countries (7%). By yearend, about 630 Mt of resources with 180 Mt of magnesium content had been identified. The expansion of Indústria Química Xilolite S.A.'s calcined magnesite plant in Brumado, Bahia, (to 28,000 t/yr from 4,000 t/yr) continued (Departamento Nacional de Produção Mineral, 2002d, p. 71-72).

Phosphate Rock.—Production of phosphate rock concentrate amounted to about 4.7 Mt, which was about the same level as that of 2000. Production was highly concentrated (95.4%, or 4.5 Mt) in four mining companies—Fosfertil S.A. (Grupo Fertifós) (34%), Fertilizantes Serrana S.A. (Bunge International Group) (30%), and Ultrafertil S.A. (Grupo Fertifós) and Copebras S.A. (Anglo American) (15% each). Fosfertil and Ultrafertil were reorganized by yearend; they were controlled by Grupo Fertifós (79%) and CVRD (11%). Bunge Group controlled Fertifós (100%), Fertilizantes Serrana S.A. (52%), Cargill S.A. (33%), and Fertibrás S.A. (13%) (Ferraz, 2002, p. 5-6). The reported domestic consumption of concentrates was about 5.7 Mt/yr; this was an increase of 1% compared with that of 2000. Of the total phosphoric acid, 73% was used in the fertilizer industry; 25%, in the chemical industry; and 2%, for other uses. These usages remained almost unchanged from those of 2000. Imports of concentrates, phosphoric acid, and intermediate products were valued at \$574 million compared with those of 2000 (\$467 million) (Departamento Nacional de Produção Mineral, 2002d, p. 87-88).

Quartz.—Brazil produced 3,700 t of quartz valued at \$1.6 million. Quartz was exported mostly to Japan (31%), Hong Kong (25%), the United Kingdom (21%), Canada (8%), and Germany (4%). Quartz powder was shipped to the United Kingdom (48%), Germany (46%), and the United States (6%). Telequartzo Exportação S.A. and others produced quartz

powder, which is an important constituent in the production, in order of importance, of optic fibers, crucibles, oscillators, solar cells, wafers and integrated circuit packing, and ceramic materials of exceptional purity. Brazil's reserves were estimated to be 53 Mt (Departamento Nacional de Produção Mineral, 2002d, p. 93-94).

Salt.—The reported domestic production of marine salt was 4.6 Mt, which was about the same level as that of 2000. The State of Rio Grande do Norte continued to be the major producer of marine salt with 95.9% followed by the States of Rio de Janeiro (2.4%) and Ceará (1.7%). The domestic consumption of marine salt was 5.5 Mt. Brazil also produced 1.4 Mt of rock salt. Salgema Mineração e Química S.A. in Maceió, State of Alagoas, produced 751,000 t (51.8%) of rock salt, and Dow Química do Nordeste Ltd. (a subsidiary of Dow Chemical Co. of the United States) produced 697,000 t (48.2%) of salt from the Vera Cruz Mine in the State of Bahia (Departamento Nacional de Produção Mineral, 2002d, p. 99).

In 2001, salt imports decreased from 215,000 t to 190,000 t, or 11.6%. Imports were sea salt (23,000 t) and bulk, in order of importance, without aggregates—table salt, sodium chloride, and pure sodium (167,000 t). Imports came from Chile (98%) and the Netherlands (2%). Salt exports amounted to 765,000 t, which was an increase of 48.3% from that of 2000. Exports were sea salt (756,000 t), bulk without aggregates (4,000 t), table salt (3,000 t), and pure sodium chloride (2,000 t). Exports were shipped to Nigeria (63%), the United States (30%), Belgium and Uruguay (3% each), and Venezuela (1%). Salt was consumed by the chemical industry (chlorine and sodium manufacture) (85.4%) and others (caustic soda) (14.6%) (Departamento Nacional de Produção Mineral, 2002d, p. 100).

Other Industrial Minerals.—Potassium production increased by almost 2% to 597,860 t compared with that of 2000. Brazil imported 2.6 Mt of potash mainly from Canada (29%), Russia (20%), Germany (20%), and Israel (15%) (Departamento Nacional de Produção Mineral, 2002d, p. 91-92).

Production of gypsum was more than 1.5 Mt, which was about the same level as that of 2000. In Brazil, renewed housing and infrastructure construction activities improved the consumption of cement and plasters (Departamento Nacional de Produção Mineral, 2002d, p. 59-60).

Production of talc was 300,000 t, which was about the same level as that of 2000. Paraná was Brazil's major talc producer with 58% of the national output followed by Bahia (29%), São Paulo (12%), and Minas Gerais (1%); these represented lower volumes as a result of the depletion of some talc ores that had taken place since mid-1997 (Departamento Nacional de Produção Mineral, 2002d, p. 105-106).

Mineral Fuels

Brazil produced 487.6 million barrels of petroleum and 14.0 billion cubic meters of natural gas, which were 5% and 5.3% higher, respectively, than those of 2000. The country produced, in order of importance, crude oil, natural gas liquid, natural gas, and shale oil; production totaled 572.3 million barrels of oil

equivalent (Departamento Nacional de Produção Mineral, 2002d, p. 85-86). In 2001, Petrobrás's average production of crude oil, which included condensate and natural gas liquid, was about 1.568 million barrels per day (Mbbbl/d), which was 5% higher than that of 2000. In December, Petrobrás attained a new production record of 1.636 Mbbbl/d and was planning to reach a target of 1.9 Mbbbl/d in 2003 to 2004 (Ferraz, 2002, p. 6; Petrobrás, 2002, p. 4, 11).

Coal.—The Brazilian coal industry's mine operations were concentrated in the three southernmost States of Santa Catarina (50%), Rio Grande do Sul (49%), and Paraná (1%). In 2001, Brazilian ROM coal production was about the same level as that of 2000 (13.8 Mt), and production of energy-generation-type coal (marketable output) increased to 6.6 Mt from 6.5 Mt in 2000 and 5.6 Mt in 1999, which were increases of about 1.5% and 18%, respectively (table 1).

The main producers of ROM coal were Copelmi Mineração Ltda. with 4.6 Mt followed by Companhia Riograndense de Mineração S.A. (CRM) (2.2 Mt), Companhia Carbonífera Metropolitana S.A. (1.2 Mt), and Carbonífera Circuíma S.A. (1.6 Mt). Coal demand increased mainly because the thermoelectric plants were operating at full capacity in these three States. Domestic coal (6.3 Mt) was used by Santa Catarina (56.5%), Rio Grande do Sul (42.1%), and Paraná (1.4%). To meet Brazil's metallurgical coal demand, 15 Mt valued at \$530 million was imported; this was an increase of 11% compared with that of 2000.

Imports came from the United States (33%), Australia (27%), South Africa (10%), and Canada (8%). Brazil imported 1.6 Mt of mineral coal coke as well, which was an increase of 78% compared with that of 2000; China was the main supplier. Total coal consumption reached 17 Mt, which was about the same level as that of 2000. The steel industry consumed 62% of metallurgical coal, 33% was used for the thermoelectric generation, and 5%, for the petrochemical and pulp and paper industries (Departamento Nacional de Produção Mineral, 2002d, p. 38).

The higher consumption of electricity in the country was reaching the limits of the hydroelectric generating capacity, which is rationed during periods of drought. Brazil was planning a priority thermoelectric generating program based mostly on natural gas and coal and would involve 49 new power stations based mainly on natural gas. Three of them to be built in Rio Grande do Sul will be coal fired. These new powerplants were part of the Government's 17-gigawatt emergency plan (supplied largely by Electrobrás S.A.) to cope with the increased demand of electricity. CRM was planning to invest \$3 million to produce 2.5 Mt/yr in early 2003. Circuíma and Metropolitana were negotiating with Usina Termoelétrica do Sul Catarinense to supply coal to produce 400 megawatts (MW). In July 2000, Chinese investors signed a letter of intent with the State of Rio Grande do Sul to perform technical and economic feasibility studies on a thermoelectric plant in the Candiota region. Most Brazilian coals have a lower content of carbon and a higher content of ash compared with the Colombian coals in the Guajira area. Total Brazilian coal reserves were estimated to be 7,400 Mt (Departamento Nacional de Produção Mineral, 2002d, p. 37-38; Ferraz, 2002, p. 2-3).

Natural Gas and Petroleum.—Brazil produced 38.5 million cubic meters per day of gas, which was 5.7% higher than that of 2000. The gas pipeline that links the Enchova platform in the offshore Campos Basin to Macaé, Rio de Janeiro, had 5 million cubic meters per day of gas flow added to the Rio de Janeiro and the São Paulo markets; offshore gas production accounted for 58% of the total. Petrobrás signed two separate agreements with Yacimientos Petroleros Fiscales de Argentina and with Yacimientos Petroleros Fiscales de Bolivia to supply natural gas to Brazil. The Argentina-Brazil gas pipeline linked Aldeia Brasileira in Argentina to Porto Alegre in Rio Grande do Sul. The \$2 billion 3,150-km Bolivia-Brazil gas pipeline started operation and will increase the supply of natural gas along the 1,970 km of pipeline between Santa Cruz de la Sierra, Bolivia, and Guararema, Brazil, to supply Mato Grosso do Sul, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul with 8 million cubic meters per day into 2005, 16 million cubic meters per day from 2005, and to 30 million cubic meters per day from 2010.

The natural gas share of the country's energy mix was 3% in 2001 and will be 12% in 2010. Petrobrás continued producing natural gas in the Gulf of Mexico and recovered gas from the Frederick Field, which was 27 km off the Louisiana coast (Departamento Nacional de Produção Mineral, 2002d, p. 53-54, 86; Ferraz, 2002, p. 7). In 2001, Petrobrás negotiated and acquired stakes on concession areas in the following countries—Argentina in the Neuquina Basin (100%), Bolivia in the Rio Hondo block (50%), Colombia in the upper Madalena Basin (50%), Trinidad and Tobago in deep waters (19%), Angola in the lower Congo Basin (15%), and Nigeria (negotiations are in progress) (Petrobrás, 2002, p. 42-43).

Brazil produced 1.4 Mbbbl/d of petroleum, which was 5% higher than that of 2000. Imports of crude oil and derivatives were valued at \$4.3 billion compared with exports valued at \$1.7 billion. Brazil's imports of petroleum were 326 Mbbbl at a value of \$3.3 billion. The main sources were Nigeria (28.0%), Saudi Arabia (26.0%), Argentina (10.0%), Iraq (9.0%), and other countries (27.0%) (Departamento Nacional de Produção Mineral, 2002d, p. 86; Ferraz, 2002, p. 7; Petrobrás, 2002, p. 21).

Uranium.—Brazil owned the fifth largest uranium reserves in the world (Rapouso Dos Santos, 2000, p. 204). The country's indicated reserves amounted to 21.9 Mt of uranium oxide (U_3O_8) and 67 Mt of inferred reserves; minable reserves contained about 103,200 t at a grade of 0.104% U_3O_8 . Private interests were permitted to participate in uranium exploration and production in Brazil through state-owned joint ventures; no more than 20% of the country's uranium reserves may be exported (Departamento Nacional de Produção Mineral, 2001, p. 389-391).

Reserves

Brazil was among the world leaders in reserves of some mineral commodities. According to the Departamento Nacional de Produção Mineral (2002a, p. 17), the commodities were ranked as follows: colombium (niobium), first; graphite and kaolin, second; aluminum, talc, and vermiculite, third;

magnesite and tin, fourth; and iron ore and manganese, sixth (table 3).

Infrastructure

Brazil's railroads comprised a total 30,539 km (2,129 km electrified), of which the broad gauge was 5,679 km of 1.600-m gauge (1,190 km electrified); the standard gauge, 194 km of 1.440-m gauge; and the narrow gauge, 24,666 km of 1.000-m gauge (930 km electrified). In addition, three rails had dual gauge—336 km of 1.000-m and 1.600-m gauge. The country had a total of almost 2 million kilometers (Mkm) of roads—184,140 km paved and 1.8 Mkm gravel and dirt. Brazil had 50,000 km of navigable inland waterways, and pipelines for petroleum products, 4,762 km; for natural gas, 4,246 km; and for crude oil, 2,980 km. The major shipping ports were Belém, Fortaleza, Ilheus, Manaus, Paranagua, Porto Alegre, Recife, Rio de Janeiro, Rio Grande, Salvador, Santos, and Vitoria. Among the merchant marine's 271 ships, 82 were bulk vessels; 56, tankers; 15, chemical tankers; 10, liquefied gas tankers; 14, combination ore and oil vessels; and 2, combination bulk vessels (Vale, 2002, p. 18-23; U.S. Central Intelligence Agency, 2002§).

In 2001, Brazil's installed electrical generating capacity was 52,865 MW. Total production of electric power for the year was 291,630 gigawatthours, which translated into 1,370 kilowatthours per capita. Brazil's primary domestic energy supply encompassed the following: hydroelectric, 95%; petroleum and natural gas, 2.6%; nuclear energy, 0.8%; and others, 1.6% (Vale, 2002, p. 18-23; U.S. Central Intelligence Agency, 2002§).

The Bolivia-Brazil pipeline (owned by a consortium of the Royal Dutch/Shell Group, Enron Energy Corp. and Petrobrás) was the largest of the various cross-border energy projects. Argentina supplied gas to Rio Grande do Sul's new thermoelectric plant, two additional pipelines were to take Argentine gas to Brazil's southern market, and another project was to supply energy to Brazil from a powerplant in Uruguay. The total pipeline network remained at 12,790 km. In northern Brazil, a transmission line supplied energy to Roraima from Venezuela. The majority of these projects were being developed by the private sector as a result of internationalization, liberalization, and privatization. State-owned corporations entered into partnerships with private domestic and foreign investors (Chodorowski and Carneir, 2001; Petrobrás, 2002, p. 22).

Negotiations were also completed between the Brazilian Government and five companies, four of which were foreign subsidiaries. The companies involved were Alcan, Alcoa, Billiton, Camargo Corrêa Industrial S.A. (Brazil), and Dow Chemical, USA. Brazil and the five companies will build a 1,200-MW dam on the Tocantins River on the border between the States of Maranhão and Tocantins; the dam will be named Tucuruí. The construction of the dam was estimated to cost about \$1 billion; Billiton has pledged \$350 million (Vale, 2002, p. 23). This new dam appeared to be necessary because demand for hydroelectricity was growing at a rate faster than that of its supply. This increased demand could exceed the 2001 supply in a very few years. The supply of subsidized electricity from the

Tucuruí Dam had been exceeded by the mining and industrial activities in 2001 in the Tocantins area. The 10% electrical subsidy was expected to be phased out by 2004 (Vale, 2002, p. 20). Alcoa acquired ownership of one concession as part of a consortium, and Alcan obtained the right to build three separate hydroelectric power stations (Mining Journal, 2002a). Constran S.A. and Construção e Comércio de Grupo Itamaraty planned to construct an additional 1,718 km of railroad to be linked to the existing railroad system. The cost of the new system was projected to be \$2.5 billion. This addition will connect to the existing system, which runs through Vitória, Espírito Santo; Belo Horizonte, Minas Gerais; Santos, São Paulo; and Chapadao do Sul, Mato Grosso do Sul. This new railroad system will run from Chapadao do Sul to Cuiabá, Mato Grosso, and Santarem, Pará, branching from Cuiabá to Porto Velho, Rondônia (Vale, 2002, p. 22).

Outlook

Brazil is one the world's most important mining countries with significant production of a range of minerals and metals. Key factors in continuing to offer a favorable climate for investors are keeping inflation under control, coming to grips with its fiscal deficit, providing stable rules for capital repatriation and profit remittances, and reducing the tax burden, tariffs, and nontariff barriers. These factors, along with its reviewed 1988 Constitution, are expected to position Brazil well into the next decade. As an exporter of mineral commodities, the country is poised to gain from the continued depreciation of the Brazilian real caused by the financial risks, which, in part, were triggered by the more-severe crisis in Argentina. The reduced FDI to \$22.6 billion in 2001 from \$32.8 billion in 2000 into the Brazilian economy somehow reflects the uneasiness in the financial markets. Other foreign investors, however, have confidence in the country, which will support continued economic growth and investments in technology well into the next decade.

No deferment of a major investment decision was reported. Even firms that have financed with borrowed U.S. dollars, which include CVRD, have the natural hedge provided by their exports. CVRD will invest about \$6 billion in mineral project developments and acquisitions by 2007. The significance of the investment would be to increase CVRD's market capitalization to \$25 billion from its 2001 level of about \$10 billion (Mining Journal, 2002b). The Brazilian economy, however, was affected by the volatility of the international financing market, depressed prices for mineral exports, and the country's power shortage owing to its worst drought in decades, which affected the country's hydroelectric power generating capacity (Prates, 2001; Mining Journal, 2002a).

The various sectors of the Brazilian economy recorded diverse rates of growth—minerals, 3.4%; agriculture, 3.0%; services, 2.5%; and industrial, 0.6 % (Departamento Nacional de Produção Mineral, 2002a, p. 1; Banco Central do Brasil, 2002c§). If that positive rate of economic growth in the minerals sector is sustained into 2001 and beyond, then it should continue its expansion as the demand for mineral exports and fabricated steel goods increases. Mercosur has undergone dramatic changes in natural gas and power markets owing to the

increase in cross-border energy investment opportunities, domestic gas consumption, and privatization of the energy sector. Brazil has become the center of an increasingly rapid process of energy integration in South America owing to the country's gas market, which is in full evolutionary mode with an unsatisfied energy demand and a great potential for growth.

Investments into the Brazilian mining industry are expected to continue to enhance exploration and mine development activities, particularly in iron ore, gold, and emeralds, in order of importance. This trend should continue as several corporations were forming consortiums and acquiring exploration properties, mining prospects, and permits, particularly for iron ore, gold, diamond, base metals, and oil and gas, in order of importance.

After the steel industry, CVRD, and other sectors of the Brazilian economy, such as energy, services, telecommunications, and transportation were privatized, new projects in the oil and gas sectors will continue to be opened up to mergers and joint-venture projects with domestic and foreign investors; thus, the Brazilian economy is expected to remain sustainable and competitive within an inclusive globalization and internationalization and privatization processes into the new century.

The existing Brazilian infrastructure is of particular interest to the minerals and its related industries. Brazil has a good industrial base capable of supplying most of the required mining equipment, has a modern and reliable transportation and communication systems, and can provide skilled labor, modern mining technology, and an efficient network of supporting services. Improvements and additional infrastructure, however, would have a direct bearing on Brazil's ability to increase industrial and minerals production competitively. The sectors most likely to be affected will be those that will depend most heavily on electricity and transportation facilities.

Brazil's dramatic electricity crisis will continue to create short- to medium-term slowdown in the aluminum, automobile, steel, petrochemical, and pulp and paper industries, in order of importance, which depend heavily on energy and exports; however, likely they will benefit most from a new and improved power-generating infrastructure. The 46 expected thermal generation plants to be built in the foreseeable future would be the major driver for growth in gas and/or coal demand. Brazil, however, would need to have the necessary regulatory resolutions, which include gas and coal prices, in place to motivate private investment.

Brazil's dynamic and diverse economy, coupled with its sizable consuming market and its membership in Mercosur, will continue to attract the interest of investors of all types and origins. The Amazon region alone was considered to have possibilities for major undiscovered mineral wealth in addition to the large reserves of iron ore, manganese, bauxite, gold, and tin, in order of importance. A factor that may have a negative effect on mineral development over the longer term was the concern over biodiversity in the Amazon rain forest. Much will depend on the approaches to be used for economic and social development while protecting the environment in a sustainable way.

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Comissão Nacional de Energia Nuclear
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22290-Rio de Janeiro-RJ-Brasil
Companhia de Pesquisa de Recursos Minerais
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Esplanados dos Ministerios-Bloco 6-5º Andar
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Conselho Nacional do Petróleo
SGAN-Q.603 Modulos J, I e H
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Rio Doce Geológica e Mineração, S.A.
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Major Publications

Associação Brasileira dos Produtores de Ferroligas (ABRAFE),
Sao Paulo, Brazil: ABRAFE Yearbook, annual.
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TABLE 1
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/ METALS	1997	1998	1999	2000	2001 e/
Aluminum:					
Bauxite, dry basis, gross weight	11,671,000	11,961,000	13,839,000	13,846,000	13,850,000 3/
Alumina	3,088,000	3,322,000	3,515,000	3,743,000	3,750,000
Metal:					
Primary	1,189,000	1,208,000	1,249,600 r/	1,271,400 r/	1,130,700 3/
Secondary	148,000	170,000	190,000	210,000	210,000
Beryllium, beryl concentrate, gross weight	7	5	11	13	13
Cadmium, metal, primary e/	300	300	300	300	300
Chromium:					
Crude ore	300,734 r/	554,813 r/	457,851 r/	611,200 r/	420,000
Concentrate and lump, Cr ₂ O ₃ content	112,274	209,596	207,123	276,105	190,000
Marketable product 4/	46,115	81,886	103,015	69,271	47,600
Cobalt:					
Mine output, Co content by hydroxide e/	400	400	400	900	900
Metal, electrolytic 5/	266	364	630 e/	900	900
Columbium-tantalum ores and concentrates, gross weight:					
Columbite and tantalite e/	190	330	330	330	330
Djalmaite concentrate e/	10	10	10	10	10
Pyrochlore concentrate, Cb ₂ O ₅ content	25,688	33,795	31,352	31,190	31,200
Copper:					
Mine output, Cu content	39,952	34,446	31,371	31,786	32,000
Metal:					
Primary	177,060	167,205	193,014	185,345	185,000
Secondary	54,100	54,150	54,220	54,300	54,300
Gold:					
Mine output kilograms	41,062	37,787	42,367	42,025	42,000
Garimpeiros (independent miners) do.	17,426	11,780	10,267	8,368	8,500
Total do.	58,488	49,567	52,634	50,393	50,500
Iron and steel:					
Ore and concentrate (marketable product): 6/					
Gross weight thousand tons	184,970	197,500	194,000	208,800	208,700 3/
Fe content do.	121,355	131,670	128,040	138,600	140,000
Metal:					
Pig iron do.	25,013	25,111	25,060	27,723	27,781 3/
Ferroalloys, electric-furnace: e/					
Chromium metal	37	40	40	40	40
Ferrocilcium silicon	25,000	25,000	25,000	25,000	25,000
Ferrochromium	74,485 3/	72,507 3/	90,784 3/	134,562 r/ 3/	84,428 3/
Ferrochromium silicon	5,000	5,000	5,000	5,000	5,000
Ferrocolumbium	16,681 3/	20,516 3/	18,866 3/	18,218 3/	18,000
Ferromanganese	153,000 3/	122,000	110,000 3/	121,277 r/ 3/	96,016 3/
Ferromolybdenum	47	50	50	50	50
Ferronickel	9,350 3/	8,077 3/	6,502 3/	6,347	6,400
Ferrophosphorus	2,000	2,000	2,000	2,000	2,000
Ferrosilicon	212,183 3/	210,000 3/	210,000 3/	188,735 r/ 3/	159,345 3/
Ferrosilicon magnesium	15,000	15,000	15,000	15,000	15,000
Ferrosilicon zirconium	1,500	1,500	1,500	1,500	1,500
Ferrotitanium	500	500	500	500	500
Ferrotungsten	25	25	25	25	25
Ferrovandium	3,000	3,000	3,000	3,000	3,000
Inoculant	25,000	25,000	25,000	25,000	25,000
Silicomanganese	175,000 3/	124,000	110,000 3/	171,304 r/ 3/	180,235 3/
Silicon metal	136,884 3/	120,000	120,000	166,344 r/ 3/	112,123 3/
Total	855,000	754,000	743,000	884,000 r/	734,000
Steel, crude, excluding castings thousand tons	25,100	25,800	24,600 r/	27,300	26,718 3/
Semimanufactures, flat and nonflat e/ do.	25,000	25,000	25,000	25,000	18,006 3/
Lead:					
Mine output, Pb content in concentrate	8,729	7,567	10,281	8,832	8,800
Metal, Secondary	44,500	48,000 r/	52,000 r/	50,000 r/	47,000 3/

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001 e/
METALS--Continued					
Manganese, metal:					
Primary e/	6,500	6,500	6,500	6,500	6,500
Secondary e/	1,600	1,600	1,600	1,600	1,600
Manganese ore and concentrate, marketable, gross weight 4/	2,124,000	1,940,000	1,656,000	2,192,000	2,200,000
Nickel:					
Mine output (ore)	2,760,787	2,603,757	2,990,657	2,790,184	2,790,000
Ni content in ore	31,936	36,764	41,522	45,317	45,300
Ferronickel, Ni content	9,350	8,077	6,502	6,347	6,300
Rare-earth metals, monazite concentrate, gross weight e/	200 3/	200	200	200	200
Silver 7/ kilograms	26,598	34,000	42,000	41,000	41,000
Tin:					
Mine output, Sn content	18,078	14,237	13,202	13,773	14,200
Metal:					
Primary	17,525	14,600	12,787	13,825	13,800
Secondary e/	250	250	250	250	250
Titanium concentrates, gross weight:					
Ilmenite	97,174	103,000	96,000	123,000	123,000
Rutile	1,742	1,800	4,300	3,162	3,200
Tungsten, mine output, W content	70	--	13 r/	14 r/	14
Zinc:					
Mine output, Zn content	152,634	87,485	98,590	100,254	100,300
Metal:					
Primary	185,701	176,806	187,010	191,777	192,000
Secondary e/	7,000	7,000	7,000	7,000	7,000
Zirconium, zircon concentrate, gross weight 8/	19,252	20,132	27,160	29,805	30,000
INDUSTRIAL MINERALS					
Asbestos:					
Crude ore e/	3,950,000	3,950,000	3,950,000	3,950,000	3,950,000
Fiber	208,447	198,332	188,386	209,332	209,300 3/
Barite:					
Crude	44,755	55,977	48,789	55,462	55,500
Beneficiated	51,961	46,632	44,906	53,741	54,000
Marketable product e/ 4/	65,000	65,000	65,000	65,000	65,000
Calcite e/	35,000	35,000	35,000	35,000	35,000
Cement, hydraulic thousand tons	38,096	39,942	40,270	39,208	39,500
Clays:					
Bentonite (beneficiated)	230,000	220,000	274,623	273,975	274,000
Kaolin:					
Crude	2,764,040	3,259,518	3,598,326	4,100,000	4,100,000
Beneficiated	1,165,047	1,373,892	1,516,700	1,734,787	1,735,000 3/
Marketable product 4/	764,743 r/	964,268 r/	1,156,593 r/	1,390,636 r/	1,200,000
Diamond: e/					
Gem thousand carats	100	100	900 3/	1,000 3/	1,000
Industrial do.	600	600	600	600	600
Total 9/ do.	700	700	1,500 3/	1,600 3/	1,600
Diatomite:					
Crude	15,448	14,303	14,601	10,164	10,200
Beneficiated	11,228	10,162	7,867	7,201	7,200
Marketable product e/ 4/	13,100	13,100	13,100	13,100	13,100
Feldspar:					
Crude	89,708	200,000	220,000	115,000	115,000
Marketable product: e/ 4/					
Feldspar	122,000	122,000	122,000	122,000	122,000
Leucite	5,000	5,000	5,000	5,000	5,000
Sodalite, crude	500	500	500	500	500
Total	128,000	128,000	128,000	128,000	128,000
Fluorspar:					
Crude ore	247,109	220,911	98,000	130,976	131,000
Concentrates, marketable product:					
Acid-grade	66,858	61,024	38,209	30,131	30,000
Metallurgical-grade	11,174	11,058	6,717	12,831	13,000
Total	78,032	72,082	44,926	42,962	43,000

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001 e/
INDUSTRIAL MINERALS--Continued					
Graphite:					
Crude e/	650,000	650,000	650,000	650,000	650,000
Marketable product:					
Direct-shipping crude ore	9,397	10,747	NA	NA	NA
Concentrate	31,190	50,622	53,503	71,208	71,000
Total	40,587	61,369	53,503	71,208	71,000
Gypsum and anhydrite, crude	1,507,114	1,631,957	1,456,309	1,541,109	1,540,000
Kyanite: e/					
Crude	750	750	750	750	750
Marketable product 4/	600	600	600	600	600
Lime, hydrated and quicklime	6,469	6,229	6,137	6,273	6,300
thousand tons					
Lithium, concentrates	6,948	9,485	11,122	10,875	11,000
Magnesite:					
Crude	1,030,171	1,109,351	868,604	1,006,654	1,010,000
Beneficiated	294,629	308,300	259,834	279,876	280,000
Mica, all grades	4,000	4,000	3,000	4,000	4,000
Nitrogen, N content of ammonia	1,018,600	948,600	948,000 e/	950,000 e/	950,000
Phosphate rock including apatite:					
Crude: e/					
Mine product	27,000	27,000	27,000	26,300 3/	26,300 3/
Of which, sold directly	35	35	35	35	35
Concentrate:					
Gross weight	4,276	4,421	4,344	4,725	4,700
P ₂ O ₅ content	1,510	1,561	1,543	1,687	1,700
Pigments, mineral, other, crude e/	2,000	2,000	2,000	2,000	2,000
Potassium (KCl)	466,984	544,200	580,380	586,140	597,860 3/
Potash, marketable (K ₂ O)	280,164	326,489	348,231	351,681	352,000
Precious and semiprecious stones except diamond, crude and worked: e/					
Agate	3,000	3,000	3,000	3,000	3,000
Amethyst	1,000	1,000	1,000	1,000	1,000
Aquamarine	20	20	20	20	20
Citrine	100	100	100	100	100
Emerald	90	90	90	90	90
Opal	500	500	500	500	500
Ruby	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Sapphire	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
Topaz	50	50	50	50	50
Tourmaline	80	80	80	80	80
Other	500	500	500	500	500
Quartz crystal, all grades	2,169	1,594	1,470	3,651	3,700
Salt:					
Marine	5,064	5,353	4,528	4,626	4,600
Rock	1,452	1,484	1,430	1,448	1,400
Silica (silix) e/	1,600	1,600	1,600	1,600	1,600
Sodium compounds: e/					
Caustic soda	1,050,000	1,050,000	1,050,000	1,050,000	1,050,000
Soda ash, manufactured (barilla)	200,000	200,000	200,000	200,000	200,000
Stone, sand and gravel: e/					
Dimension stone:					
Marble, rough-cut	200,000	200,000	200,000	200,000	200,000
Slate	50,000	50,000	50,000	50,000	50,000
Crushed and broken stone:					
Basalt	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Calcareous shells	450,000	450,000	450,000	450,000	450,000
Dolomite	3,500	3,500	3,500	3,500	3,500
Gneiss	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
Granite	60,000	60,000	60,000	60,000	60,000
Limestone	60,000	60,000	60,000	60,000	60,000
Quartz 10/	250,000	250,000	250,000	250,000	250,000

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001 e/	
INDUSTRIAL MINERALS--Continued						
Stone, sand and gravel--Continued: e/						
Crushed and broken stone--Continued:						
Quartzite:						
Crude	400,000	400,000	400,000	400,000	400,000	
Processed	200,000	200,000	200,000	200,000	200,000	
Sand, industrial	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	
Sulfur:						
Frasch	20,476	24,582	23,232	23,720	23,700	
Pyrites	2,307	1,137	--	--	--	
Byproduct:						
Metallurgy	175,511	186,806	217,119	217,238	217,000	
Petroleum	33,823	36,973	57,962	81,762	82,000	
Total	232,117	249,498	298,313	322,720	323,000	
Talc and related materials:						
Talc:						
Crude	285,614	289,000	294,000	300,000	300,000	
Marketable product e/ 4/	2,000	2,000	2,000	2,000	2,000	
Pyrophyllite, crude	158,675	161,000	160,000	150,000	150,000	
Vermiculite:						
Concentrate	23,000	24,300	23,400	23,400	23,400	
Marketable product 4/	5,000	4,200	3,100	3,100	3,100	
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous:						
Run of mine	thousand tons	6,500	5,500	6,900	13,800	13,800
Marketable 4/	do.	5,542	5,485	5,618	6,461	6,600
Coke, metallurgical, all types	do.	90	43	50	50	50
Gas, natural, gross	million cubic meters	9,461	10,412	11,898	13,291	14,000
Natural gas liquids	million 42-gallon barrels	2,541	2,654	3,345	3,694	5,860 3/
Petroleum:						
Crude	thousand 42-gallon barrels	318,290	365,365	413,121	464,280	487,640 3/
Refinery products: 11/ 12/						
Liquefied petroleum gas	do.	40,055	58,288	10,950	13,140	14,112 3/
Gasoline	do.	115,409	167,943	128,854	134,722	144,691 3/
Jet fuel	do.	478	695	533	557	598 3/
Kerosene	do.	22,449	32,668	25,064	26,175	28,112 3/
Distillate fuel oil	do.	177,435	258,203	198,106	206,885	222,221 3/
Lubricants	do.	5,001	7,277	5,584	5,831	6,315 3/
Residual fuel oil	do.	103,364	150,415	115,406	118,698	127,482 3/
Other	do.	84,871	123,502	94,758	100,893	108,359 3/
Refinery fuel and losses	do.	--	--	NA	NA	NA
Total	do.	549,062	798,991	579,255	606,901	651,890 3/

e/ Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. r/ Revised. NA Not available. -- Zero.

1/ Table includes data available through October 2002.

2/ In addition to the commodities listed, bismuth, molybdenite, and uranium oxide are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Direct sales and/or beneficiated (marketable product).

5/ Source: Cobalt Development Institute.

6/ Includes sponge iron as follows, in thousand metric tons: 1997 to 2001--270 (estimated).

7/ Officially reported output; of total production, the following quantities are identified as secondary silver (the balance being silver content of other ores and concentrates), in kilograms: 1997--32,000; 1998--40,000; and 1999 to 2001--50,000.

8/ Includes baddeleyite-caldasite.

9/ Figures represent officially reported output plus official Brazilian estimates of output by nonreporting miners.

10/ Apparently includes crude quartz used to produce quartz crystal (listed separately in this table), as well as additional quantities of common quartz.

11/ Figures represent officially reported production to the United Nations (Energy Statistics Yearbook) by the Ministry of Mines and Energy of Brazil.

12/ Minerals Questionnaire, 1997-2001, and Petrobrás Magazine, 1998-2002.

TABLE 2
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS			
Aluminum	Albras-Alumínio Brasileiro S.A. (Albras) [Companhia Vale do Rio Doce (CVRD), 51%; Nippon Amazon Alumínio Co. (NAAC), 49%]	Belém and Vila do Conde, Pará State (two smelters)	400 (metal).
Do.	Alcan Alumínio do Brasil S.A. (Alcan Aluminum Ltd., 100%)	Saramenha, Minas Gerais State (smelter and refinery)	100 (metal).
Do.	do.	do.	150 (alumina).
Do.	Alcan Empreendimentos Ltda. (Alcan Alumínio do Brasil S.A., 100%)	Laminação de Pindamonhangaba, São Paulo State (smelter)	280 (metal).
Do.	Alcan Alumínio Poços de Caldas (Alucaldas) (Alcan Alumínio do Brasil S.A., 100%)	Poços de Caldas, Minas Gerais State (mine)	1,000 (bauxite).
Do.	Alcoa Alumínio S.A. (Alcoa) (Aluminum Co. of America, 53.66%; Billiton plc, 46.34%)	Poços de Caldas, Minas Gerais State (mine)	400 (bauxite).
Do.	do.	São Luiz, Maranhão State (refinery)	550 (alumina).
Do.	do.	São Luiz, Maranhão State (smelter)	239 (metal).
Do.	Alumínio do Brasil Nordeste S.A. (Alcan Aluminum Ltd., 100%)	Aratu, Bahia State (smelter)	120 (metal).
Do.	Billiton Metais S.A. (Billiton plc, 100%)	São Luis, Maranhão State (refinery)	375 (metal), 450 (alumina).
Do.	Alumínio do Norte do Brasil S.A. (Alunorte) (private, 100%)	Barcarena, Pará State (refinery)	1,550 (alumina).
Do.	Companhia Brasileira de Alumínio (CBA) (private, 100%)	Poços de Caldas, Minas Gerais State (mine)	1,000 (bauxite).
Do.	do.	Sorocaba, São Paulo State (refinery)	500 (alumina).
Do.	do.	Sorocaba, São Paulo State (smelter)	220 (metal).
Do.	Companhia Geral do Minas (private, 21%; Aluminum Co. of America, 79%)	Poços de Caldas, Minas Gerais State (refinery)	275 (alumina).
Do.	do.	Poços de Caldas, Minas Gerais State (smelter)	90 (metal).
Do.	Mineração Rio do Norte S.A. (MRN) (CVRD, 40%; CBA, 10%; Alcan Empreendimentos Ltda., 12%; Billiton plc, 14.8%; Norsk Hydro Comercio e Industria, 5%; Reynolds Alumínio do Brasil, 5%; Alcoa, 13.2%)	Oriximina, Pará State (mine)	11,000 (bauxite).
Do.	do.	Papagalo, Pará State (mine)	2,000 (bauxite).
Do.	do.	Trombetas, Pará State (mine)	2,000 (bauxite).
Do.	Vale do Sul Alumínio S.A. (Aluvale) (Government, 27%; private, 25%; Shell do Brasil S.A., 44%)	Santa Cruz, Rio de Janeiro State (smelter)	86 (metal).
Do.	Aluvale (CVRD, 49.7%; Billiton Metais S.A., 41.5%; Cia. Cataguazes, 8.8%)	do.	93 (metal).
Do.	Reynolds Internacional do Brasil (Reynolds, 42.5%; Bradesco Bank, 42.5%; J.P. Morgan, 15%)	Sorocaba, São Paulo State (smelter)	5.4 million (cans).
Do.	Consortium Paragominas S.A., (CVRD, 48.7%; MRN, 24.6%; Nippon Amazon Aluminum Co., 12.2%; CBA, 5.7%; others, 8.8%)	Jabuti, Pará State (mine)	1,500 (bauxite).
Do.	do.	Jabuti, Pará State (alumina)	1,200 (alumina).
Chromite	Coitezeirio Mineração S.A. (COMISA) (private, 75.4%; Bayer do Brasil S.A., 24.6%)	Campo Formosa, Bahia State (mine)	50 (ore).
Do.	Companhia de Ferro Ligas da Bahia (FERBASA) (private, 100%)	Campo Formoso, Bahia State (mine)	370 (ore).
Do.	do.	Campo Formoso, Bahia State (beneficiation plant)	292 (concentrate).
Columbium	Companhia Brasileira de Metalurgia e Mineração (CBMM) (Grupo Moreira Sales S.A., 55%; Molycorp, Inc., 45%)	Araxá, Minas Gerais State (mine)	1,200 (ore).
Do.	do.	Araxá, Minas Gerais State (beneficiation plant)	50 (pyrochlore).
Do.	Mineração Catalão de Goiás Ltda. (MCGL) (Bozzano Simosen S.A., 68.5%, and Anglo American plc, 31.5%)	Ouvidor and Catalão I, Goiás State (mines)	700 (ore).
Do.	do.	Ouvidor, Goiás State (plants)	13 (pyrochlore).
Copper	Mineração Caraiba S/A (Grupo PARANAPANEMA, 100%)	Jaguari, Bahia State (mine)	130 (ore).
Do.	do.	Jaguari, Bahia State (beneficiation plant)	90 (concentrate).
Do.	Caraiba Metais S/A (CMSA) (private, 100%).	Camaçari, Bahia State (refinery)	220 (metal).
Ferroalloys	Companhia Brasileira Carbureto de Calcio (CBCC) (private, 100%)	Santos Dumont, Minas Gerais State (plant)	54.
Do.	Prometal Produtos Metalúrgicos S.A., 60%; Elkem A/S, 40%	Marabá, Pará State (plant)	500.
Do.	Nova Era Silicon S.A. (CVRD, 49%; Mitsubishi Corp., 25.5%; Kawasaki Steel Corp., 25.5%)	Nova Era, Minas Gerais State	48.

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS--Continued				
Ferroalloys--Continued:		Companhia Ferro-Ligas de Bahia S.A. (FERBASA, 100%)	Pojuca, Bahia State (plant)	194.
Do.		Companhia Ferro-Ligas Minas Gerais (MINASLIGAS, 100%)	Pirapora, Minas Gerais State (plant)	58.
Do.		Companhia Paulista de Ferro-Ligas (CPF) (private, 100%)	Barbacena, Caxambu, Jeceaba, Passa Quatro, and Passa Vinte, Minas Gerais State; Corumba, Matto Grosso do Sul State; and Xanxere, Santa Catarina State	326.
Do.		Italmagnesio S.A. Indústria e Comercio (ISAIC) (private, 100%)	Braganca Paulista, São Paulo State; and Varzeada Palma, Minas Gerais State (two plants)	63.
Gold	kilograms	Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Gold mines in the States of Minas Gerais, Bahia, and Pará	18,000.
Do.	do.	Mineração Morro Velho S.A. (AngloGold Ltd., 100%)	Novo Lima, Raposos, and Sabara, Minas Gerais State; and Jacobina, Bahia State (four mines)	7,000.
Do.	do.	Mineração Serra Grande S.A. (AngloGold Ltd., 50%; TVX Gold Inc., 50%)	Serra Grande, Minas Gerais State (mine)	6,000.
Do.	do.	São Bento Mineração S.A. (Eldorado Gold Corp., 100%)	Santa Barbara, Minas Gerais State (mine)	4,000.
Do.	do.	Rio Paracatu Mineração S.A. (Rio Tinto plc, 51%; Autram S/A, 49%)	Paracatu Mine, Minas Gerais State (mine)	7,500.
Do.	do.	Mineração Maracá S.A. (MMSA) (private, 100%)	São Vicente Mine, Mato Grosso State (mine)	1,500.
Iron ore		Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Mine, Minas Gerais State	12,000.
Do.		Itaminas Comércio de Minérios S.A. (ICMSA) (private, 100%)	Itaminas, Minas Gerais State	5,000.
Do.		Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Serra dos Carajás, Pará State	55,000.
Do.	do.		Itabira, Ouro Preto, Santa Barbara, Xavier, Tamandúa, Capao, and Mato, Minas Gerais State (seven mines)	105,000.
Do.		Ferteco Mineração S.A. (FERTECO) (Exploration Bergbau GmbH, 100%)	Ouro Preto and Brumadinho, Minas Gerais State (two mines)	12,800.
Do.		S.A. Mineração da Trindade (SAMITRI) (private, 100%)	Mariana, Rio Piracicaba, Itabira, Ouro Preto, and Sabara, Minas Gerais State (five mines)	9,300.
Do.		Minerações Brasileiras Reunidas S/A (MBR) (BHP Ltd., 85.3%; Mitsui e Co. Ltd., 14.7%)	Capão Xavier, Tamandúa, and Capitão do Mato, Minas Gerais State (three mines)	32,000.
Do.		Samarco Mineração S.A. (SAMITRI, 51%; BHP Ltd., 49%)	Alegria, Minas Gerais State (mine)	13,500.
Do.		SOCOIMEX S.A. (CVRD, 100%)	Mato, Minas Gerais State (mine)	7,000.
Lead		Mineração Boquira S.A. (MBSA) (private, 100%)	Boquira, Bahia State (mine)	300 (ore).
Do.	do.		Boquira, Bahia State (beneficiation plant)	310 (concentrate).
Manganese		Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Corumba, Minas Gerais State (mine)	2,500 (ore).
Do.	do.		Igarapé Azul, Carajás, Pará State (beneficiation plant)	1,400 (concentrate).
Do.		Urucum Mineração S.A. (CVRD, 100%)	Corumba and Ladario, Mato Grosso do Sul State (two mines and plant)	1,500 (ore), 800 (concentrate).
Do.		Construtora Polares Ltda. (CPL) (private, 100%)	Corumba Minas Gerais State (mine)	200 (ore).
Nickel		Companhia Niquel Tocantins (CNT) (Grupo Votarantin, 100%)	Niquelândia, Goiás State (mine)	20 (ore).
Do.	do.		Niquelândia, Goiás State (refinery plant)	10 (electrolytic Ni).
Do.		Mineração Serra da Fortaleza (Rio Tinto plc, 100%)	Fortaleza, Minas Gerais State (mine)	19 (nickel matte).
Do.		CODEMIN S.A. (Anglo American plc, 100%)	Niquelândia, Goiás State (refinery)	20 (metal).
Steel		Aço Minas Gerais S.A. (AÇOMINAS) (private, 100%)	Rodovia, Minas Gerais State	2,000.
Do.		Companhia Aços Especiais Itabira (ACESITA) (Government, 90.9%; private, 9.1%)	Timoteo, Minas Gerais State (stainless steel plant)	600.
Do.		Companhia Siderúrgica Belgo-Mineira (CSBM) (private, 100%)	João Monlevade, Minas Gerais State	1,000.
Do.		Companhia Siderúrgica de Tubarão (CST) (private, 100%)	Serra, Espírito Santo State	3,000.
Do.		Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Redonda, Rio de Janeiro State	4,600.
Do.		Companhia Siderúrgica Paulista (COSIPA) (private, 100%)	Cubatão, São Paulo State	3,900.
Do.		Usinas Siderúrgicas de Minas Gerais, S.A. (USIMINAS) (private, 100%)	Ipatinga, Minas Gerais State	4,400.
Tin		Mineração Jacunda Ltda. (MJL) (private, 100%)	Santa Barbara, Novo Mundo, and Potosi, Rondônia State (six mines)	108 (ore).
Do.	do.		Santa Barbara, Novo Mundo, and Potosi, Rondônia State (three beneficiation plants)	450 (concentrate).

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS--Continued			
Tin--Continued:	Grupo PARANAPANEMA (private, 100%)	Aripuana, Mato Grosso State; Ariquemes, Rondônia State; Novo Aripuana, Pitinga, and Presidente Figueiredo, Amazonas State; and São Felix do Xingu, Pará State (five mines and two plants)	5,420 (ore).
Do.	Grupo PARANAPANEMA (private, 100%)	Piraporada Bom Jesus, São Paulo State (refinery)	1,400 (concentrate), 25 (metal).
Do.	Marmoré S.A. (MSA) (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	20 (ore).
Titanium	Rutilo e Ilmenita do Brasil S.A. (RIBSA, 100%)	Mataraca, Paraíba State (mine)	4,200 (ore).
Do.	do.	Mataraca, Paraíba State (two beneficiation plants)	120 (concentrate).
Zinc	Companhia Mineira de Metais S.A (CMM) (Grupo Votarantin, 100%)	Vazante, Minas Gerais State (mine)	800 (ore).
Do.	do.	Vazante, Minas Gerais State (beneficiation plant)	48 (concentrate).
Do.	do.	Três Marias, Minas Gerais State (refinery)	165 (metal).
Do.	Companhia Paraibuna de Metais S.A (CPM) (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	100 (ore).
Zirconium	Nuclemon Minerio-Química Ltda. (Government, 100%)	São João da Barra, Rio de Janeiro State (mine)	660 (ore).
Do.	do.	Itapemirim, Espírito Santo State (mine)	90 (ore).
Do.	do.	Prado, Bahia State (mine)	90 (ore).
Do.	do.	Prado, Bahia State (three beneficiation plants)	123 (concentrate).
Do.	do.	Prado, Bahia State (three separation plants)	90 (concentrate).
INDUSTRIAL MINERALS			
Asbestos	Sociedade Anônima Mineração de Amianto (SAMA) (private, 100%)	Cana Brava and Minaçu, Goiás State (mines)	9,000 (ore).
Do.	do.	Cana Brava and Minaçu, Goiás State (beneficiation plant)	230 (concentrate).
Cement	Cimento Santa Rita S.A. (CSSA) (CSSA, 50%; Holder Cimento S.A., 50%)	Itapevi and Salto de Pirapora, São Paulo State (two plants)	2,200.
Do.	Companhia Cimento Portland Itau (CCPI) (Grupo Votarantin, 100%)	Itau de Minas, Minas Gerais State (three plants)	2,400.
Do.	Companhia de Cimento Portland Paraíso (CCPP) (CCPP, 50%; Lafarge Group, 50%)	States of Espírito Santo, Goiás, Minas Gerais, and Rio de Janeiro (five plants)	4,000.
Do.	Companhia de Cimento Portland Rio Branco (Grupo Votarantin, 100%)	Rio Branco do Sul, Paraná State (two plants)	5,000.
Do.	Camargo Correia Cimentos S.A. (CCSA) (private, 100%)	Ijaci, Minas Gerais State (plant)	1,600.
Diamond	Mineração Tejucana S.A. (MTSA, 100%)	Diamantina, Minas Gerais State (mine)	100.
Fluorspar	Mineração Nossa Senhora do Carmo Ltda. (MNSCL) (private, 100%)	Cerro Azul, Paraná State (two mines)	180 (ore).
Do.	Mineração Santa Catarina Ltda. (MSCL) (private, 100%)	Morro da Fumaça, Santa Rosa de Lima, Rio Fortuna, Santa Catarina State; and Tangúá, Rio de Janeiro State (three mines and beneficiation plant)	100 (ore), 120 (concentrate).
Graphite	Nacional de Grafite Ltda. (NGL) (private, 100%)	Itapecerica, Pedra Azul, Salto da Divisa, Minas Gerais State (three mines)	80 (ore).
Do.	do.	Itapecerica, Pedra Azul, Salto da Divisa, Minas Gerais State (three beneficiation plants)	60 (concentrate).
Do.	Grafita MG Ltda. (GML) (private, 100%)	Mateus Leme, Zerra Azul, Minas Gerais State (two mines)	20 (ore).
Do.	Marmoré Mineração e Metalurgia Ltda. (MML) (Grupo PARANAPANEMA, 100%)	Maiquinique, Bahia State (mine)	10 (ore).
Gypsum	Companhia Brasileira de Equipamento (CBE) (private, 100%)	Codo, Maranhão State, and Ipubi, Pernambuco State (two mines)	100.
Do.	Companhia de Cimento Portland Paraíso (CCPP) (private, 100%)	Ipubi, Pernambuco State (mine)	50.
Kaolin	Caulim da Amazônia S.A. (CADAM) (private, 100%)	Mazagão, Amapá State (mine)	720 (ore).
Do.	do.	Mazagão, Amapá State (beneficiation plant)	360 (concentrate).
Do.	do.	Adam Mine, Rio Jari, Amazonas State	660 (concentrate).

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
INDUSTRIAL MINERALS--			
Continued			
Kaolin--Continued	Pará Pigmentos S.A. (PPSA) (private, 100%)	Pará Mine, Pará State	500 (concentrate).
Do.	Ymerys Rio Capim Caulim S.A. (RCCSA) (private, 100%)	Rio Capim Mine, Pará State	500 (concentrate).
Do.	Empresa de Mineração Horii Ltda. (EMHL) (private, 100%)	Biritiba and Mogi das Cruzes, São Paulo State (two mines)	200 (ore).
Do.	do.	Biritiba and Mogi das Cruzes, São Paulo State (two beneficiation plants)	180 (concentrate).
Limestone	Companhia de Cimento Portland Paraiso (CCPP) (private, 100%)	States of Goiás, Minas Gerais, and Rio de Janeiro (five mines)	2,000.
Do.	Companhia de Cimento Portland Rio Branco (CCPRB, 100%)	Rio Branco do Sul, Paraná State (three mines)	5,500.
Do.	S.A. Industrias Votorantim (SAIV) (private, 100%)	States of Rio de Janeiro and São Paulo (four mines)	1,000.
Magnesite	Magnesita S.A. (MSA) (private, 100%)	Brumado, Bahia State (one major mine and numerous small mines)	1,000 (ore).
Do.	do.	Brumado, Bahia State (two beneficiation plants)	280 (concentrate).
Phosphate rock	Fertilizantes Serrana S.A. (Bunge International Group, 100%)	Araxá, Minas Gerais State (mine)	5,000.
Do.	Copebras S.A.(Copebras) (Anglo American plc, 100%)	Ouvidor, Goiás State (mine)	4,400.
Do.	Fosfertil S.A. (Grupo Fertifôs, 79%; CVRD, 11%; public, 10%)	Tapira, Minas Gerais State (two mines)	10,500.
Do.	Ultrafertil S.A. (Grupo Fertifôs, 79%; CVRD, 11%; public, 10%)	Araxá, Minas Gerais State (mine)	5,000.
Quartz	Telequartzo Exportação S.A. (TESA) (private, 100%)	Cristal, Minas Gerais State (mine)	6.0.
Salt, rock	Frota Oceânica Brasileira S.A. (FOBSA) (private, 100%)	Jacupiranga, São Paulo State (mine)	6,000.
Do.	Dow Química do Nordeste Ltd. (DQNL) (Dow Chemical Co., 100%)	Vera Cruz, Bahia State (mine)	1,000.
Do.	Cia. Nacional de Alcalis S.A. (CNA) (private, 100%)	Alcalis Grupo, Rio Grande do Norte State	1,500.
Do.	Salgema Mineração e Química S.A. (SMQ) (private, 100%)	Salgema, Maceió, Alagoas State (mine)	1,000.
MINERAL FUELS			
Coal	Carbonifera Circiúma S.A. (CCSA) (private, 100%)	Circiúma and Sideropolis, Santa Catarina State (two mines)	1,600.
Do.	Companhia Carbonífera Metropolitana S.A. (CCM) (private, 100%)	Circiúma, Sideropolis, and Urussanga, Santa Catarina State (three mines)	1,200.
Do.	Copelmi Mineração Ltda. (COPELMI) (private, 100%)	Arroio dos Ratos, Butia, and Charqueadas, Rio Grande do Sul State (four mines)	4,600.
Do.	Companhia Riograndense de Mineração S.A. (CRM) (private, 100%)	Circiúma and Urussanga, Santa Catarina State (two mines)	2,600.
Petroleum thousand 42-gallon barrels	Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%; private, 11.8%; public, 6.8%)	Fields in the States of Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Rio de Janeiro, Rio Grande do Norte, Pará, Maranhão, and Sergipe (99)	220,000.
Petroleum products	do.	Refineries in the States of Amazonas, Bahia, Ceará, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, and São Paulo	503,000.
Do.	Refinaria de Petróleo Ipiranga S.A. (RPISA) (private, 100%)	Ipiranga, Rio Grande do Sul	3,400.
Do.	Refinaria de Petróleos de Manguinhos S.A. (RPMSA) (private, 100%)	Manquinhos, Rio de Janeiro State	3,650.

TABLE 3
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES IN 2001 1/

(Thousand metric tons unless otherwise specified)

Commodity	Reserves	World ranking	World percent
Asbestos, fiber	16,300		NA
Bauxite, ore	2,500,000	3	7.8
Chromite, Cr ₂ O ₃	7,000		0.1
Coal, all types	7,372,000		0.6
Columbium, pyrochlore, and columbite ore	5,000	1	90.0
Copper, metal content	12,000		1.8
Fluorspar, ore	7,000		2.1
Gold, metal	metric tons 2,000		3.8
Graphite, ore	95,000	2	21.0
Gypsum	1,250,000		NA
Iron ore, 60% to 65% Fe content	19,500,000	6	6.5
Kaolin	4,000,000	2	28.2
Lead, metal content	1,000		0.7
Magnesite	180,000	4	5.2
Manganese, metal content	51,000	6	1.0
Natural gas 2/	million cubic meters 231,000		NA
Nickel, metal content	6,000		4.0
Petroleum 2/	thousand 42-gallon barrels 9,000,000		0.8
Phosphate rock	298,000		0.8
Talc and pyrophyllite	178,000	3	19.0
Tin, metal content	metric tons 540,000	4	6.8
Titanium, TiO ₂	4,000		0.7
Uranium, U ₃ O ₈	metric tons 163,000		NA
Zinc, metal content	5,000		1.2
Zirconium, ore	2,000		2.8

NA Not available.

1/ Summário Mineral 2001-2002.

2/ Petróleo Brasileiro, S.A. annual report 2001-2002.